HISTORY IN YOUR HAND: DESIGN ELEMENTS TO ENHANCE ADOPTION OF A MOBILE MULTIMEDIA HISTORICAL TOUR

A DISSERTATION SUBMITTED TO THE GRADUATE DIVISION OF THE UNIVERSITY OF HAWAI‘I AT MĀNOA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

IN

LEARNING DESIGN AND TECHNOLOGY

MAY 2017

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Keywords: Museum Education, Mobile Devices, TAM, Informal Learning, Technology Adoption

ACKNOWLEDGEMENTS

This undertaking has been the work of many. It could never have come to completion without the encouragement, pushing, assistance, guidance, badgering, advocacy, endorsement, accommodation, influence, persuasion, exhortation, collaboration, cooperation, facilitation, involvement, patience and sacrifice of others. My thanks and gratitude to:

Patience. My committee, Beth Pateman, Peter Leong, Curtis Ho, and Jenifer Winter for their support and patience during this long process.

Guidance. My Chair, Dr. Ellen Hoffman who so often showed me the way when I had clearly lost sight of it.

Collaboration. Deanna Pasternak and Adam Tanners who were unhesitating about providing candid and unflinching feedback and advice for the technical pieces of this project.

Facilitation. Sherman Seki with Hamilton Library's University Archives and Manuscripts who was invaluable in my search for historical images.

Cooperation. Morris Lai, David Sherrill and Dean Donald Young who so generously shared their historical knowledge of the College of Education and so clearly demonstrate their love for it.

Involvement. The participants who tested my project with such enthusiasm and deliberation.

Encouragement. My friends and family who always encouraged (and propelled) me to continue on this path.

Sacrifice. And ultimately, thanks to Gene and Guzelle who have sacrificed in so many ways, both big and small to help me successfully find my way to the end of this endeavor.

ABSTRACT

The purpose of this qualitative design case study was to determine the design elements that can lead to technology acceptance of a mobile multimedia tour at an informal historical site. Using rapid prototyping, a tour prototype was developed using a low-cost Website building platform. The tour was then tested with thirteen participants in two phases of testing. Methods of data collection included both surveys and interviews. The participants engaged in the study by taking the mobile multimedia tour at the historical site and completing a survey about their experience with the tour. Semi-structured interviews were conducted with eight of these participants. The tour was revised based on the findings from the initial data collection and the eight interview participants completed a survey on the revised tour. The Technology Acceptance Model (TAM) was used as a framework to examine factors that could affect acceptance of the mobile multimedia tour. The results of this study led to development of general design guidelines to enhance visitor engagement for mobile multimedia tours. Based on this study, to enhance adoption of mobile multimedia tours design should provide visitors with the ability to have fine control over their access to content, the type of content they want to access and the way they access the content. Opportunity for additional visual stimulation, by allowing images to be viewed in conjunction with the audio tour also increased participant satisfaction and intention to use the tour. This study has identified four variables for multimedia mobile tour design, control, stimulation, simplicity and reliability that can lead to adoption of the technology. It is hoped that these guidelines can be used to develop effective and engaging mobile multimedia tours for a variety of museum and leisure environments. The study has shown that it is possible to create an impactful multimedia tour experience at low-cost for leisure institutions.

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CHAPTER 1. INTRODUCTION

Since the 1950s museums and historical sites have used audio guides to enhance information transfer to visitors. Providing a whispering expert in the ear, these guides have provided visitors with audio information on exhibits and sites in both random-access and directed tours, allowing visitors the freedom to experience informal learning on their terms. Popular with visitors, audio tours have become a staple for most museum environments, but with the advent of new multimedia mobile technologies, the possibility of providing visitors with multi-sensory tour experiences is becoming a new and compelling reality. However, care must be taken to ensure that new technologies introduced in a museum environment serve to enhance visitor engagement and learning, and not distract visitors or diminish engagement. This study examined an implementation of a multimedia mobile tour at an outdoor historical site to determine design elements that best enhance visitor engagement and would lead to visitor adoption of this technology.

Statement of the Problem

The recent explosion of newer technologies now allows museums and other leisure institutions to go beyond the auditory channel and provide visitors with access to multimedia and multi-sensory information on mobile devices. For the purposes of this study a 'mobile device' is defined as a handheld computerized device that uses application software or 'apps' and can connect to the Internet.

Interaction with multimedia mobile devices is by nature more complex than interaction with audio tours, and there is conflicting research on the learning impact and adoption of such technologies. With traditional audio tours, the visitor can visually engage with an object or exhibit while consuming interpretive material through their auditory channel. However, with multimedia tours, the visual channel is also used as a conduit for interpretive information. One concern is that the visitor may engage with the technology or device rather than the interpretive information being presented, or that the visitor will become distracted or frustrated by the

technology, leading to a reduction in engagement with objects or exhibits (Filippini-Fantoni & Bowen, 2008).

Effective learning through multimedia is a complex area for study. Mayer's (2009) Cognitive Theory of Multimedia Learning is a learner-centered approach based on human cognition that posits the use of three different types of memory--sensory, working and long-term memory--during the process of learning through the use of multimedia. He recommends twelve principles for design of multimedia that maximize cognition and learning. In addition, Merrill (2008) has identified first principles of instruction for engaging learners, which include a task-centered approach, and principles of activation, demonstration, application, and integration. Application of these learning and design principles could provide guidelines for development of effective and engaging multimedia tours.

Purpose

The purpose of this qualitative design case study was to determine the design elements that lead to technology acceptance for learning with mobile multimedia tours at an informal historical site. The study discerned how to provide interpretive information to visitors through mobile multimedia in a way that would lead to general adoption of the technology for visitors to a museum or historical site. The results of this study also led to development of general design guidelines that enhance visitor engagement for mobile multimedia tours. It is hoped that these guidelines can be used by a variety of museum environments to develop effective and engaging multimedia tours.

Research Questions

This project explored how design elements can affect user adoption of a mobile multimedia tour for visitors to a museum or historical site. The research questions were:

RQ1. How can design elements affect user value/enjoyment of a multimedia tour?

RQ2. How can design elements affect ease of use of a multimedia tour?

Significance of the Study

As museums and historical sites strive to retain and attract new visitors, visitor engagement is becoming an increasingly critical focus. For over 60 years, mobile audio tours

have allowed these institutions to provide additional, customized information to visitors to increase their engagement. With the predominance and ubiquity of mobile technologies, institutions have new opportunities to reach a variety of audiences in innovative and personal ways through multimedia. However, since mobile multimedia technologies result in far greater sensory experience and require more technical expertise than audio-only tours, research must be done to ensure that design elements and features are constructed to enhance visitor experience and learning, not detract from it.

Adoption of multimedia mobile technology can be an expensive and resource-hungry endeavor, which can be cost-prohibitive for many institutions suffering low funding and budget cutbacks (Filippini-Fantoni & Bowen, 2008). Better understanding of essential features and design elements can not only aid in visitor acceptance of this technology for informal learning, but can also serve to provide institutions with information on essential design elements and features that will allow them to self-produce multimedia tours with a minimum of technology and resource investment.

Conceptual Framework

This project used the Technology Acceptance Model (TAM) to examine what factors can affect acceptance of the multimedia tour. The TAM is based on the Theory of Reasoned Action (Fishbein & Ajzen, 1975), which states that intention to behave in a certain way or take a certain action results from two elements, attitude toward the behavior and belief of others' attitude toward the behavior.

Perceived usefulness and perceived ease of use are the two factors that affect attitude toward using according to the TAM. Attitude towards using leads to behavioral intention to use, which then results in actual use. Perceived ease of use also can affect perceived usefulness, which can also directly affect behavioral intention to use. External variables can impact both perceived usefulness and perceived ease of use.

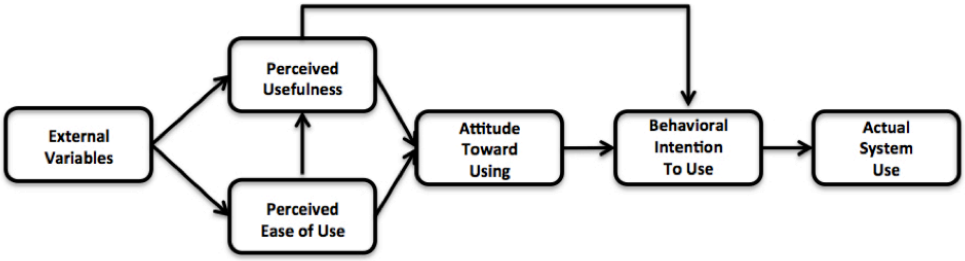

Figure 1. Technology Acceptance Model (Davis, 1989)

For this study, system use or adoption was the goal of the handheld multimedia tour. However, a multimedia tour engages the visitor in a different way than the traditional and highly used audio tour since it makes use of both the auditory and visual channels for information dissemination. Therefore, adoption of multimedia tour technology cannot be assumed based on the success of audio tours. Users may find the multimedia tour and use of the handheld device to be too challenging or they may find that it does not provide any additional benefit compared to an audio tour.

In order to determine how to increase the potential for actual system use of multimedia mobile tours, the TAM was used to examine factors that lead to adoption. Since perceived usefulness and perceived ease of use are the critical factors that affect attitude toward using, these factors were the focus of the study. Modification of the TAM included altering 'perceived usefulness' to 'perceived value/enjoyment' to address informal learning in a leisure environment. The study determined the external variables that lead to enhanced perceived usefulness for visitors as well as enhanced perceived ease of use. External variables in the model were classified as the design elements and features of the multimedia tour.

Summary of Methodology

The research methodology for this study was a qualitative design case study. According to Yin (2013, p. 16) a case study "investigates a contemporary phenomenon in depth and within its real-world context" and addresses explanatory research questions. This project was an in-depth examination of design elements for a multimedia tour within an outdoor historical site context, and examined research questions that attempted to determine design elements that best enhanced engagement and learning.

According to Boling (2010) a design case is a "description of a real artifact or experience that has been intentionally designed." This study matches this description as the COE Multimedia Tour was intentionally designed to explore design features that would enhance adoption of a mobile multimedia tour. The study will also be presented as a design narrative, describing the problem solving approach to design with a discussion of the evolution of the design. It follows Mor's (2011) description of design narratives portraying "the complete path leading to an educational innovation, not just its final form – including failed attempts and the modifications they espoused." This study will present both successes and failures of the design, proving transparency as Howard (2011) claims, "Design failures may also be the most interesting aspects of the case for readers who share common dilemmas, constraints, goals or contexts."

To address the research questions, the study involved development of a prototype that was tested in a real-world context. The study was constructed to have three distinct parts, development, testing and redesign/testing. Prototype development for this project consisted of two phases of evaluation and revisions, each exploring a different aspect of the design of the multimedia tour.

Development of the prototype was conducted using application of design and development research (Richey & Klein, 2014). This study was designed to provide design guidelines for effective multimedia tours for museum institutions. This cutting-edge technology may be poised to replace popular and ubiquitous museum audio tours, an interpretive tool critical for visitor interpretation and engagement. Therefore, developmental research was appropriate for this study.

Rapid prototyping is an agile development process. Designs are tested early and often, allowing for flexibility and frequent iterations for design development. The first phase of the development process used rapid prototyping to create the initial prototype. This phase of development also focused on technical evaluation of the tour (see Figure 2). Experts provided evaluation of the tour iterations from a technical standpoint to help guide the development. The second phase was evaluation of the tour by content experts that evaluated the accuracy of the tour from an historical standpoint (see Figure 2). Revisions were made based on this input and a final prototype was released for testing with participants.

The V1.0 testing phase of the study also involved two stages of participant testing. The first phase involved participants with significant experience with mobile devices who could

identify major technical problems with the prototype. The second stage of participant testing used participants with no explicit experience with mobile technologies. Participants in the second stage of testing most closely matched the audience intended for tours in a real world setting. Surveys and interviews were the methods of data collection for the testing phase.

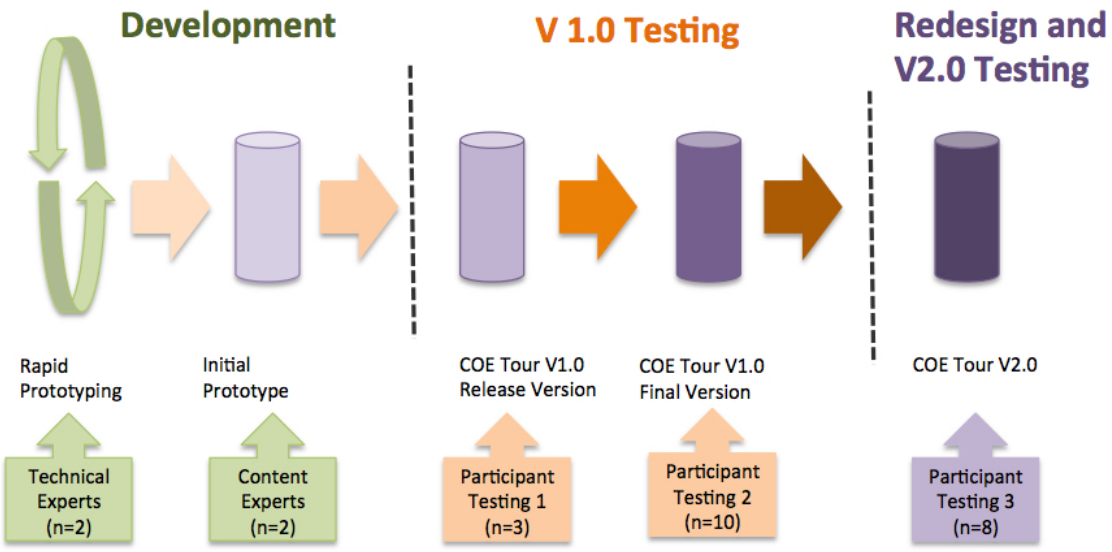

Figure 2. Development and Testing Process

Data collected was analyzed with qualitative methods involving coding with an inductive approach to identify themes from the participant responses. Analytic memos were kept to ensure a comprehensive approach to coding and data analysis.

After analysis of the data collected during the V1.0 testing, revisions were made to the prototype to address the findings. Participants were asked to complete a survey to evaluate the revised V2.0 tour and the data collected was analyzed also with an inductive approach to identify participant response to the revisions.

Role of the Researcher

My interest and expertise in this study have evolved from my current position and my educational background. I am an Information Technology (IT) Specialist at the College of Education at the University of Hawai‘i Mānoa campus. I have an M.Ed in Educational Technology from the University of Hawai‘i and a Certificate in Museum Studies from the University of Washington. I have a strong interest in museum technologies and my association

with the College of Education has inspired an interest in preserving and disseminating information about the unique history of the College of Education campus.

In this study I acted as both designer/developer and researcher. This may have lead to some research bias. However, Richey and Klein (2014) note that this is a "common and often unavoidable by-product of the practical constraints of studying real-life design projects" and suggest that bias can be avoided if the researcher takes special care with "instrument design, data collection, and triangulating multiple sources of data" (p. 148).

Limitations

Limitations of this study included small sample size and a homogeneous sample so may not be applicable to all museum or historical site visitors. In addition, this project focused on designing a multimedia tour for a specific outdoor historical site. This environment does not have any formal exhibits or structure and there are no existing informational or directional signs. Using a multimedia tour in sites and exhibits with more formal infrastructure and signage may have different outcomes.

Definition of Key Terms

Informal Learning. Learning that does not occur within a formal educational setting, is voluntary and does not have a formal curriculum.

Multimedia. Presenting both words (such as spoken or written text) and pictures (such as illustrations, graphs, animation, or video). (Mayer, 2005)

Museum. The International Council of Museums (ICOM) defines a museum as follows: *A museum is a non-profit, permanent institution in the service of society and its development, open to the public, which acquires, conserves, researches, communicates and exhibits the tangible and intangible heritage of humanity and its environment for the purposes of education, study and enjoyment.* For this research project the term museum includes outdoor historical sites, zoos, science centers, botanical gardens, and any other sites that can be classified under the ICOM definition.

Mobile Device. A handheld computerized device that uses application software or 'apps' and can connect to the Internet.

Summary

Museums have been providing interpretive information to visitors through a single sensory channel, the auditory channel, for over 60 years. However, new technologies have emerged that can enrich interpretive information with multimedia, providing visitors with greater engagement and opportunities for learning by making use of multiple sensory channels. Multimedia tours have many potential benefits for museums and their visitors, but they may also potentially lead to visitor distraction or induce reduced visitor engagement with objects or exhibits if not implemented correctly.

This study explored adoption of a multimedia mobile tour for museum environments from a design perspective to determine what factors can best enhance adoption of a multimedia tour. It focused on design factors that can increase visitor perception of usefulness and ease of use of a multimedia tour, leading to both enhanced engagement and enhanced learning. It is hoped that the findings from this study will lead to effective, new avenues for visitor engagement within a variety of museum environments.

Chapter two includes the review of literature for this study. Chapter three describes the methodology and the theory and conceptual framework that provide the foundation for the study. Chapter three also includes description of the data collection, data analysis and validation for the study. Chapter four discusses the design of the first version of the tour and the testing of this version. Chapter five discusses the redesign of the tour and retesting. Chapter 6 presents the results of the study. Instruments for the study and interpretive material from the tour are included in the Appendix.

CHAPTER 2. REVIEW OF LITERATURE

This dissertation studies the interface design and user experience and as it pertains to adult learners using mobile technology in informal learning environments, specifically an outdoor historical site. Therefore, the literature review explores: user design and interaction, heritage sites and visitor engagement, museum Websites, electronic tours in museums and design for multimedia devices. The literature review also presents the history of the College of Education at The University of Hawai‘i Mānoa, the proposed site for the multimedia mobile tour, and the Theory of Reasoned Action and the Technology Acceptance Model used to frame the study.

User Design and User Experience

Good design is the primary focus for this dissertation project. The technology developed for the project strives, through good design, to create an effective and engaging tool for learning. Numerous books, articles and Websites discuss principles and techniques for good design, and some of these are discussed below. However, as a foundational starting point, this literature review will begin by examining a fundamental aspect of good design: the user. Donald Norman (2013, p. 9) states that “good design starts with an understanding of psychology and technology” and he presents the Human-Centered Design (HCD) approach that examines human needs, capabilities and behavior, then designs to accommodate those needs. Norman (2013, p. 9) notes that this self-described design philosophy requires a “good understanding of people and the needs that the design is intended to meet.”

The User in User Design

Designing for optimal user interaction or, user design, can be approached from three different perspectives: neuropsychology, usability and visual design. Often these three approaches are intertwined and interdependent, creating complex interactions. Naturally, the central focus of user design is the user. However, Goodwin (2009) warns that users should only be seen as a resource for determining the problem, not as a resource for finding a solution. She states that users are not experts in product design, but that they can be experts in identifying the

problem. She concludes that to achieve solutions to design problems both the user and the designer must work cooperatively to combine knowledge and expertise.

Both Cooper (1999) and Colborne (2011) emphasize the importance of designing for the mainstream user, or 'survivor' in Cooper's parlance, rather than for the expert user, or Cooper's 'apologist.' Expert users or apologists are more willing to put up with complications and bad design, whereas the mainstream user or survivor appreciates simplicity and ease of use and may become frustrated and disenchanted with complexity and obfuscation within design. Expert users are also more likely to spend the time and effort to research advanced features and options, whereas mainstream users may be uninterested in expending extra effort in this direction.

Nielsen (2013) also explores usability from the standpoint of the average or mainstream user and finds that these users are focused firmly in the present and as a result, user expertise stagnates in terms of user interface. He finds that once a user has discovered essential features to perform required tasks, little additional exploration occurs unless needed. To address user disinterest in exploring advanced device features, Nielsen suggests designing with fewer features and making these features easily visible with visible signifiers or affordances. Tips for users presented as 'just-in-time learning', error messages, the ability to easily undo an action, and previews for actions are other techniques he suggests to increase user learning.

User Interaction

Norman (2013, p. 9) states that "good design requires good communication." As such, a device or technology must communicate with the user by its appearance and explain itself. User and technology or device must be able to interact smoothly and harmoniously, especially when things go awry. To ensure that this communication is effective, Norman (2013) claims that good design uses affordances, signifiers, constraints, mappings and feedback to provide effective communication for the user. He labels these elements as the Fundamental Principles of Interaction. Norman defines affordances as the definition of the way an object can be used. Signifiers act as indicators to show how an object or design is to be used. Mapping is used to show relationships between two things, especially a control and its result. Feedback is the communication of the result of an action or an indicator that an action has been confirmed. Norman (2013) also includes within the Fundamental Principles of Interaction the concept of a conceptual model, or mental model. This model is an innate understanding of how an object or

design works which resides within the mind of the user. Norman (2013) states conceptual or mental models can help users predict behavior and provide understanding of operations.

Simplicity is of paramount importance in user interaction design according to Colborne (2011) and he provides four strategies for achieving simplicity in design: remove features, organize items into sensible grouping, hide non-essential items, and displace complexity. These strategies for simplicity also resonate with principles of Gestalt theory embraced by visual designers designing for optimal learning such as proximity, similarity, continuity, closure, figure/ground and symmetry (Johnson, 2010)

Simplicity and visual design are only two factors for successful user interaction. Engagement is a crucial aspect that has roots in both neuropsychology and the behavioral sciences. Anderson's model of User Experience Hierarchy of Needs (Anderson, 2011) is a top-down model that begins with a subjective and qualitative approach of the experience desired. It moves through the levels of meaning, pleasure, convenience, usability, reliability and functionality to end up at a task-based objective and quantifiable product. Anderson (2011) notes that traditional product design and development follows the bottom-up progress on this model, starting with the functional level and not with the user experience and the meaning desired for the design. In terms of interaction design, Anderson (2011) cites feedback loops, curiosity, pattern recognition, visual imagery, and recognition over recall as factors that will increase engagement for user interaction.

From a neuropsychology standpoint several different techniques can be used to influence and increase user satisfaction or interaction: providing social validation, invoking scarcity or loss, limiting choices, invoking indebtedness, and building commitment (Anderson, 2011; Weinschenk, 2009). To increase motivation and make an experience more engaging, Anderson (2011) suggests the following techniques be used: shaping the path, commitment, endowed progress, sequencing, and shaping.

Anderson (2011) defines shaping the path as small influences that encourage users to continue or pursue a course of action, and he notes that even small commitments by users can lead to fulfillment of the commitment and engagement in larger commitments. He states that further engagement can be encouraged by endowed progress, or presenting the task as already or partially completed. Anderson (2011) describes sequencing as making a task more manageable by breaking it down into smaller pieces, and shaping as reinforcing behavior.

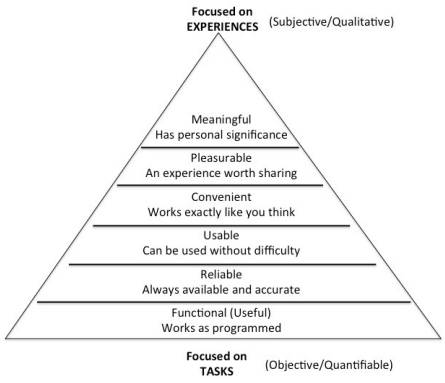

Figure 3. User Experience Hierarchy of Needs (Anderson, 2011)

Johnson (2010) emphasizes the importance of minimizing cognitive load in design and suggests the following design rules: show progress, provide guidance, be explicit, minimize complexity, ask for perception not calculation, and embrace familiarity.

Evaluating User Experience

Partala and Kallinen (2012) examine user experience from both negative and positive perspectives, claiming that focusing only on positive aspects, as is often the focus of user experience research, will provide an incomplete understanding of the experience. The researchers evaluated participants' most unsatisfying and most satisfying experiences, using the Positive and Negative Affect Schedule (PANAS), an instrument that enables evaluation of 20 emotions by using 10 psychometric scales for emotion assessment. Partala and Kallinen (2012) also examined methodology in their study, finding that qualitative methods were often unable to provide a full understanding of the hedonic and social aspects of the user experience, so recommend that a mixed-methods approach to user experience studies be used to gain richer qualitative data.

Many user experience studies examine user experience as a snapshot or initial evaluation of a technology. However, Kujala, Roto, Väänänen-Vainio-Mattila, Karapanos, and Sinnelä (2011) contend that user experience evolves over time and argue that there is relevance in examining user experience from a longitudinal perspective. To do so, the researchers have developed the UX Curve, a tool that asks users to draw a curve representation of their interaction with a technology over a period of time, providing both qualitative and quantitative data on their experience. Other researchers (Zhou, 2012) exploring user experience from a commercial

perspective agree with the longitudinal approach to user evaluation, claiming that a longitudinal approach could provide more insight to such research.

Heritage Sites and Visitor Engagement

Visitor attendance at American history museums is and has been on the decline. Carson (2008, p. 15) states that visitor attendance at American history museums has been trending downward "for more than 20 years." The recent economic crisis has only exacerbated this phenomenon. The American Association of Museums ("Museums and the American economy in 2011," 2012) reports that 29.1% of museums saw a decrease in attendance in 2011; of these 11.3% reported that the decrease in visitors was a significant decrease of 5-20%. This follows similar number of attendance reductions of 31.2% in 2009 and 30% in 2010. Reasons for this decline are varied, as are solutions to address this problem, but visitor engagement is one important factor to consider as a way to reverse this decline.

Importance of Visitor Engagement

Falk (2009) examining identity-related needs for museum visitors, states that the primary reason that visitors do not come to museums is that they do not perceive a that the museum can satisfy their identity-related needs. Falk (2009, p. 213) also states "building and sustaining audiences requires an understanding of the real needs and interests of the public."

Visitor engagement as a critical issue is not unrecognized by museums. Ballantyne and Uzzell (2011, p. 88) claim that funding shortfalls from governmental sources have led museums to seek alternate sources of funding and as such, many are placing "visitors and their satisfaction at the heart of institutional strategic planning" as alternate sources for critical funding. Museum philosophy is also changing as institutions re-think their role in terms of collections and visitors. Black (2005) states that in recent decades there has been increased pressure from governing and funding bodies, audiences and museum professionals themselves to change the presentation of collections and sites from a repository or display facility to a more visitor-centric focus. Black (2005) also states "the primary role of exhibitions and associated activities is to engage audiences directly with collections – to gain visitor attention, to hold it and to encourage reflection" (p. 271).

Moscardo (1996) looks at visitor engagement by interpreting it through the lens of mindfulness. She claims "mindfulness and mindlessness are valuable concepts in understanding how visitors respond to interpretation at historical sites" and mindful visitors are "active, interested, questioning, and capable of reassessing the way they view the world" (p. 382). She states that creating 'mindful visitors' can have a greater impact than just visitor satisfaction for historic sites, that it can lead to not only greater visitor appreciation of the site, but greater appreciation of the larger entity encompassing the site and ultimately can contribute to the sustainability of tourism generally.

Researchers de Rojas and Camarero (2008) concur, stating that it is the "interpretation and intangibles" at a site that "allows the visitor to understand, feel and relive the heritage" (p. 533) which ultimately will result, they claim, in more engagement in the site, repeat visits and even a greater interest in heritage preservation.

Interactive Experience Model

Researchers Falk and Dierking (1992) claim that all exhibit design should be driven by visitor response, and they have developed the Interactive Experience Model which explores visitor experience in museums from the interaction of three individual contexts: personal, social and physical. The model shows that at any time any one of these contexts could be dominant in influencing the visitor, and that the visitor's experience is a "continually shifting interaction" among these three contexts.

The physical context includes the physical setting of the museum and its objects. The social context encompasses the interactions the visitor has with others within the museum, including those accompanying the visitor to the museum, other museum-goers, and museum staff. The personal context includes not only the individual visitor's "experience in and knowledge of the content and design of the museum," but also the individual's "interests, motivations, and concerns" and their personal agenda for visiting the site. Falk and Dierking (1992) state that examining these three contexts can provide a lens through which to identify and interpret the visitor perspective for museum visits.

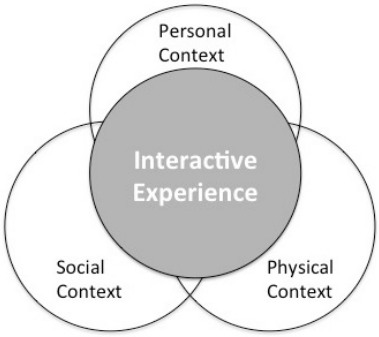

Figure 4. Interactive Experience Model (Falk & Dierking, 1992)

Improving Visitor Engagement

Carson (2008) states that visitors and their expectations have fundamentally changed and that museum visitors are now looking for a more immersive museum environment that can provide a richer experience. A 2008 study by Research Advisors ("Let the data dump begin - Historic sites and their audiences," 2008) found that 62% of visitors to outdoor historical sites visit such sites specifically to "immerse themselves in the past." Beeho and Prentice (1997) conducting a SWOT analysis (Strengths, Weaknesses, Opportunities, Threats) of an historical site found that visitors reported a desire for a more immersive environment, and considered the lack of such an experience a weakness.

Other researchers (Falk & Dierking, 1992) advise including "multisensory and multi-media" techniques to exhibits that will engage the visitor through "visual aural, and tactile means" and allow them to better contextualize and personalize content. They also suggest creating exhibits that are entertaining and serve to engage the visitor "intellectually and physically." Ultimately they claim that museum exhibits are successful if they help visitors understand their place in the world and stimulate curiosity. Similarly, one approach outlined by Black (2005) is to provide a "palette of display approaches and a layering of content" (p. 206) to support visitor engagement. Moscardo (1996) also suggests that interpretation should be varied, be interactive, be personally applicable to visitors, and be challenging.

Ballantyne and Uzzell (2011) warn that museums need to pay close attention to physical aspects such as overcrowding that can negatively affect visitor satisfaction and therefore, engagement. The researchers state that crowded conditions and long lines do not "get visitors

into a proper state of mind to appreciate the cultural treasures they have come to see" (Ballantyne & Uzzell, 2011, p. 89). Similarly, Moscardo (1996) claims that orientation is an important factor in interpretation effectiveness, stating that visitors having difficulty navigating in a built heritage site will focus resources on orientation rather than exhibits and content, thus diminishing visitor engagement.

Museum Websites

Websites for museums are becoming increasingly sophisticated and complex as more and more museums are moving from simple sites consisting of only hours, location, and special events information, to content-rich sites with extensive exhibit resources and multimedia features. As museums make this shift to more enriched sites there is greater examination of what information should be provided to users and how this information should be presented. Researchers are finding that visitors expect a museum's virtual presence to be closely integrated with their physical presence, but that their needs and expectations for each are very different (Marty, 2008). Examining research on museum Website design can provide insight and guidance for handheld devices that can provide similar information to visitors onsite.

Need for Online Presence

As museums have begun developing their online presence there has been concern that the virtual presence may reduce physical visits (Marty, 2007). In effect, the concern is that visitors will embrace the ease and convenience of the virtual environment and from that environment they will obtain access to object descriptions and images, rendering a physical visit unnecessary. However, researchers (Marty, 2007) have found that this concern is unfounded and that in fact, a museum's online presence can enhance the physical presence, and vice versa, creating a "feedback loop that should lead to increased visitation and overall visitor satisfaction" (p. 337). This study also showed that for potential visitors the institution's Website was a significant factor for determining interest in a physical visit. Marty (2008) found that visitors use museum sites as an important source for information outside of a physical visit so suggests that museums should publicize their site "before, during, and after" (p. 96) visits. He also suggests that designers of museum sites should attempt to provide experiences that cannot be replicated in a physical environment, thus creating a dynamic experience that might increase physical museum

visits. Ideally, the interaction of an institution's online and physical presence would provide an ongoing relationship between visitor and museum where visitors would visit the physical museum when possible and visiting the online environment when physical visits may not be possible.

Stewart and Marcketti (2012), studying Web sites for fashion and textile museums, reported that the museums found that an online presence also can be significantly beneficial for the institution as it can "extend the visitor's memory-making experience beyond the four walls of the museum setting" (p. 529). The researchers reported that museums felt that the online presence was a way to increase collection information, as those viewing the objects online would be inspired to contact the museum with their own information, memories, and stories about object displayed. Such interactions can not only increase visitor engagement, but also benefit the institution with additional collections information.

As the value of an online presence is becoming increasingly important for museums to enhance physical visits, researchers have also found that a badly designed site can discourage visits (Marty, 2007). Marty's study of museum Websites and museum visitors showed that visitors have strong expectations for a museum Website with specific needs and desires. These needs and desires differ before a physical visit and after a visit. To address those visiting a Website prior to a visit, the site must encourage a planned visit and form a connection with the visitor. If a site is poorly designed, this connection may fail to develop and a potential visit may be lost. However, Marty did find that it was more likely that potential visitors would decide on a physical visit to a museum based on a online visit to a museum's Website, than that visitors would decided against a physical visit based on the museum's Website.

Site Design

A. C. H. Lin and Gregor (2006), exploring learning and enjoyment in museum Web site design, found that flexibility was a key factor for learning and enjoyment and that users should be able to learn at their own pace. They also express the need for simplicity and state that visitors to museum sites are not doing do for the "purposes of tests or getting a high score" (p.10). A further study by A. Lin, Fernandez, and Gregor (2012) identified novelty, harmonization, no time constraint, and proper facilitations and associations as characteristics to enhance enjoyable informal learning for users of museum sites. To provide novelty, researchers found that sites

should frequently provide new content, new interfaces, and new functionality to stimulate learning. In terms of harmonization, the researchers found that coherence of design and functionality was important for enjoyable learning. Users valued coherent design elements such as colors and layouts as well as easy-to-use site functions. Time constraints were found by researchers to decrease the enjoyment of the learning experience in this informal learning environment. Users enjoyed the ability to learn at their own pace and have control over their learning. Control over learning was also found to be valuable for enjoyable learning in terms of proper facilitations and associations. Researchers found that user enjoyment in learning was increased by the ability to expand their learning through exploration of related sites with relevant and useful information.

Wilson (2011) examining the markup and programming behind museum sites, also explores the issue of harmony in site design, and in a comparison between museum sites and consumer sites, describes a consumerist model of museum Website design to enhance harmony in site design. He cites the use of Cascading Style Sheets (CSS) and a Content Management System (CMS) to create a controlled and consistent format which creates a 'harmonious appearance" (p. 380). He claims that the visitor is cast in the role of consumer through the use of Open Search functionality and the same layout as the Museum's shop and other retailers should be used to enhance seamless integration throughout the site.

External links were again found to be a way of increasing educational impact of museum sites through a study by A. C. H. Lin and Gregor (2006) which found that "connecting to different types of learning resources" was a "vital aspect" (p.11) for learning and enjoyment and should be considered crucial to museum sites. Wilson (2011) concurs, citing the use of ALT text and 'curtailed narrative' to inspire the visitor to access further information and therefore to "gain greater access and possession of the object" (p. 383).

Research into museum site design (A. Lin et al., 2012) found designing a multisensory experience, creating a storyline, mood building, fun in learning, and establishing social interaction to be guidelines for designing an enjoyable learning experience for museum sites. Multisensory experiences would consist of a presenting a combination of visual, auditory, kinesthetic and tactile elements. Storylines were seen as method to inspire involvement and ownership, and the presentation of a positive mood as a method to improve learning outcomes through enhancing attitude. Fun in learning was seen to include "novelty, surprise, fascination,

and the freedom to explore" and establishing social interaction through forums or blogs was found to be a method of "obtaining fulfillment through social interaction" (p. 853).

One aspect of museum site design that is still a concern for museums is limiting reproduction of site information and images. A. C. H. Lin and Gregor (2006) claim that information on sites should be sharable and conform to the Sharable Course Object Reference Model (SCORM). This conflicts with Stewart and Marcketti (2012) whose study demonstrated concerns by museum professionals of copyright infringement and image protection for Website design. In this study, participants voiced concern over losing control of intellectual property and images displayed on their site and having no way to limit inappropriate use or use without acknowledging ownership. Some solutions noted in the study were, use of copyright notices, although this was generally acknowledged by participants to be ineffective, and the use of low resolution or watermarked images.

User-Focused Website Design

Like good design in general, studies have found that a fundamental aspect of good museum Website design is consideration of the visitor, and their needs and expectations. Researchers (A. C. H. Lin & Gregor, 2006) state that a design should be user-focused and that it is "essential to consider different levels of targets" (p.13). Corredor (2006), studying the effect of prior knowledge on content use in museum sites supports this as he emphasizes that a visit to a museum site "does not guarantee that learning is taking place" (p. 208). He states that users with high prior domain knowledge will be more effective at navigating a "productive path through the museum" (p. 220), but since most museum visitors lack this prior domain knowledge they will not gain the same benefit from site content. He suggests that museum site designers must focus greater attention on the characteristics of these users and design sites accordingly. Other researchers (Cunliffe, Kritou, & Tudhope, 2001) state that visitors are central to the virtual museum experience and these users must be fully understood within the context of the design process.

Museum Website Evaluation

Website development, particularly in smaller institutions, is often performed with limited financial resources or professional expertise (Pallas & Economides, 2008) and there is little in the way of systematic evaluation tools for such sites. Pallas and Economides (2008), state that

there is a need for continual evaluation of sites in order for museums to "keep pace with the technological advances and growing users' demands and expectations" (p. 56). Other researchers agree, adding that continuing evaluation of sites is required due to "dating of content, technological change, change in visitor needs and expectations, and policy changes within the museum" (Cunliffe et al., 2001, p. 247).

To address this need, Pallas and Economides (2008) developed a quantitative evaluation tool for museum sites, MUSEF, comprised of six evaluation dimensions and 28 criteria. The six dimensions include: Content, Presentation, Usability, Interactivity & Feedback, e-Services and Technical. To evaluate usability of sites Cunliffe et al. (2001) recommends a combination of evaluation methods, but suggests that direct observation is the best method for identifying usability problems based on "user needs and users' subjective impressions" (p.248), while heuristic evaluation was best used for identifying "more technically oriented problems" (p. 248). Other researchers (A. Lin, Gregor, & Ewing, 2008) have developed instruments to go beyond basic usability for sites to evaluate user engagement and enjoyment.

Handheld Tours in Museums

Pre-dating Websites, museums have offered electronic tours of varying technological levels to users since the 1950s (Tallon & Walker, 2008) as a way to provide users with additional interpretative information. For most of this time the tours have been audio only, but more recent developments in mobile device technology have allowed museums to provide users with multi-sensory, multimedia tours. Naturally, an audio tour allows visitors the ability to process interpretive information while still viewing artifacts and exhibits, while multimedia tours consume more of the visitor's visual and cognitive resources. Little research has yet been done on the user experience for multimedia tours and how these tours may impact learning and information consumption, but examination of research into audio tours can provide a foundation for research into user experience with multimedia guides.

Tour Audience

By their very nature museums face the challenge of providing interpretive materials to a wide variety of visitors in terms of age, language, educational level and prior content knowledge. In comparison to person-led tours, electronic tours can provide users with greater control over

interpretive information, allowing users to select both what and how much interpretive information they want to receive. Museums can provide tours to visitors of different ages, languages and levels of interest by supplying varying information tracks and options (FitzGerald, Taylor, & Craven, 2013; Kang & Gretzel, 2012; Novey & Hall, 2007). Visitors can experience greater flexibility (FitzGerald et al., 2013; Novey & Hall, 2007) as they can use the electronic devices to customize or personalize their visit with random access tours (Kang & Gretzel, 2012).

Researchers have found that tailoring handheld tours to specific groups or audience demographics can result in increased visitor engagement. Gottlieb (2008) discusses projects that focus on increasing interactivity with young children in exhibits to engage the children more completely in the exhibit and therefore increase learning. Of major importance for these projects was a focus on making the technology invisible so focus would concentrate on engagement with the exhibit and collection. Interfaces were designed to be intuitive and minimal so cognitive load would not be used on navigation and interaction with the device, but instead on the objects and content. In addition, researchers found that creating innovative interfaces that would specifically appeal to the visitors and relate to the exhibit enhanced engagement. Gammon and Burch (2008) concur stating that a one-size-fits-all solution is unlikely to be successful as it does not cater to the different needs and wants of individual visitors. Instead, they advise identifying a target audience and designing the tour to match with those particular needs and wants. Filippini-Fantoni and Bowen (2008) suggest creating a variety of tours to appeal to a variety of audiences, stating that as more tours that are available, more visitors can be reached and may find a tour that will increase their engagement with the exhibit. These researchers specifically note that a variety of tours, particularly multimedia tours, may help attract new visitors that would have little interest in traditional methods of museum interpretation.

Visitor Interaction

Visitor interaction with handheld devices remains a complex area of research due to the wide variety of visitor types, visitor motivation and levels of technical exposure and expertise. Gammon and Burch (2008) state that it is essential for visitors to have an accurate mental model for a device so that they can predict response to input, understand its purpose and exert user control. They claim that effort should be made to ensure that the device behaves and responds like similar technologies that user may be familiar with. Hsi (2008) agrees, demonstrating that in

cases where users don't have an accurate mental model explanation is required for the interaction between visitor and device to be successful. Other researchers agree, claiming that conceptual barriers could result in cases where technology deviates from expected behavior (Gottlieb, 2008) and those unfamiliar with devices with experience difficulty from the outset (Filippini-Fantoni & Bowen, 2008). (Gottlieb, 2008) further argues that technology should be transparent and that interfaces should be minimal and intuitive.

Gammon and Burch also suggest that user empowerment is a critical factor for visitor interaction. They state that visitors must be aware of the flexibility of the tour, and that they have the power to control the information and obtain the particular information that is of interest to them.

Several researchers also support the use of personalization to increase device interaction and engagement (Gammon & Burch, 2008). However, other researchers state that personalization in museum technologies has not yet proven to a technology that has been introduced successfully in museum environments (Filippini-Fantoni & Bowen, 2008).

Visitor Immersion and Distraction

Research has found that audio tours can inspire imagination in visitors and cause them to relate to content more closely (FitzGerald et al., 2013). Research at historical sites has found audio tours particularly effective at immersing visitors into the historical content, although these researchers do note that introducing content not related to the current historical environment can cause disruption to the immersion. In addition, researchers (Novey & Hall, 2007) also found that although there was no perceived difference in learning between audio tours users and nonusers, the audio tour users did have a greater overall awareness of the larger themes present in the interpretative materials. In addition, users spent more time viewing exhibits than nonusers and there was less evidence of attentional fatigue (Novey & Hall, 2007).

Questions have been raised about distraction in regards to electronic tours, and some researchers (Reynolds, 2010) have found that electronic tours can actually distract users from participating fully in the exhibit or site experience, while others (Gammon & Burch, 2008) have found that properly designed tours can increase engagement with exhibits. Filippini-Fantoni and Bowen (2008) acknowledge that absorption in technology can detract from exhibits, however, they also claim that if material is appropriate and limited it can encourage greater engagement.

Concerns have been raised as well about electronic tours reducing social interaction between visitors at exhibits. Smith and Tinio (2008), examining social interaction for audio tours, noted that social interaction during museum tours was minimal, and that audio tours did not reduce social interaction more noticeable than a docent-led tour. Filippini-Fantoni and Bowen (2008) explore techniques used by mobile devices to enhance social interaction during exhibit tours, specifically texting, shared bookmarking and group games, however they state that further research must be conducted to determine the efficacy of these techniques. Walker (2008) concurs, noting low uptake of visitor feedback and post-visit contributions by visitors to a museum's Website. Although, he does also note that participation in social interaction can be increased if the focus is narrowed and visitors are given a specific subject or small number of objects as a focal point for discussion and interaction.

Other researchers (Reynolds, Walker, & Speight, 2010) have noted that device distraction either due to user unfamiliarity or device malfunction can diminish user experience. To combat this latter issue, researchers suggest institutions provide staff to help users with device problems (Kang & Gretzel, 2012) and that they carefully evaluate the new technologies they plan to introduce into their environment.

Multimedia Tour Concerns

Filippini-Fantoni and Bowen (2008) note several concerns about introducing multimedia tours in museum environments. They state that development costs are very high compared to traditional audio tours, especially since the cost of multimedia content, particularly copyrighted content, is significantly higher than audio content. Additionally, they argue that hardware is more expensive and accessories such as extended life batteries, rugged carrying cases and charging stations increase this cost. Also of concern is the fact that devices used for multimedia tours are usually consumer-grade electronics, with limited life-span. When newer models are introduced it can be difficult to obtain older models for expansion or to replaced damaged units, and newer models may not be compatible with the format or software of the existing tour.

Other concerns by Filippini-Fantoni and Bowen (2008) involve staffing and usability issues with multimedia devices. Institutions must ensure that staff or volunteers are sufficiently trained to explain device functionality with visitors, as well as be able to perform basic troubleshooting for hardware and software issues. In terms of usability, the researchers note that physically

handling a multimedia device can be unwieldy for visitors, especially if the device requires interaction with hand or stylus or in environments with interactive exhibits. The researchers note that usability issues do not end with the physicality of the device, but that interface issues can also be a concern. Maps, orientation and wayfinding can be considerably more challenging on a small screen than in print and navigation through the interface can be difficult for users if not carefully designed.

Design for Multimedia Devices

Design for mobile devices in museum environments offers many challenges, particularly as there are no recognized standards (Parry, 2008) for design and application of these devices in museums. Gammon and Burch (2008) suggest a model for designing handheld devices for a museum environment that takes into account the interactions between the visitor, the visitor's companions, the mobile device, the object being viewed and other museum visitors. In addition, they suggest that institutions must have a "detailed understanding of the visitor's needs, wants, expectations, and behaviors" (p. 35) in order to find success in development of mobile digital technologies.

Multimedia Devices in Museum Environments

Gammon and Burch (2008) state that successful mobile device design must take into account the physical environment of the museum and match with it. They note that visitors can become frustrated when objects in the exhibit are not addressed on the tour and vice versa. In addition, they note that certain exhibits with hands on interactives may force visitors to juggle the mobile device in order to engage with the exhibit, causing confusion or irritation. Hsi (2008) concurs, stating that to be successful, mobile device design needs to fit seamlessly within the context of use and integrate into the physical context. If the exhibit is a social interactive exhibit, then Hsi states that the mobile tour should support and emulate this structure otherwise the technology will have a lower success rate. Similarly, Parry (2008) concludes that successful devices must harmonize with the institution's existing practice. However, Filippini-Fantoni and Bowen (2008) warn that the physical context of some museum environments will not match with the use of multimedia devices and such devices will not be successful in these environments.

Multimedia Learning

Mayer (2009) clearly states "people learn better from words and pictures than from words alone." His Cognitive Theory of Multimedia Learning is a learner-centered approach based on human cognition that posits the use of three different types of memory, sensory, working and long-term memory, during the process of learning through the use of multimedia.

Based on his theory, Mayer (2009) has developed 12 principles for design of multimedia

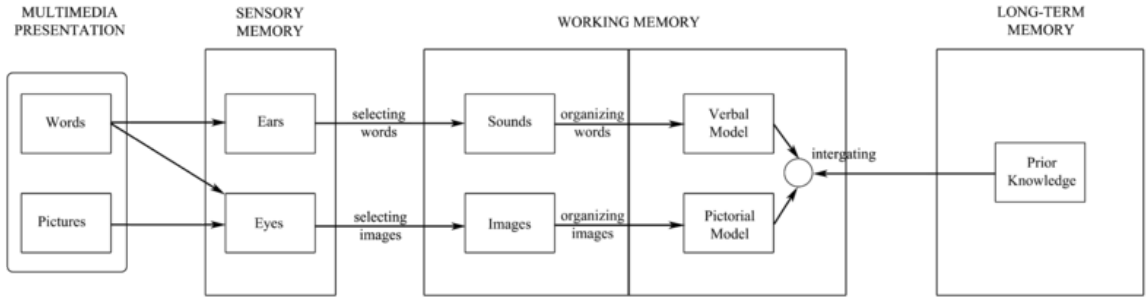

Figure 5. Cognitive Theory of Multimedia Learning (Mayer, 2009)

design for learning. The first set of principles is designed to reduce extraneous processing that he claims leads to cognitive overload, which reduces essential cognition. These principles include coherence, signaling, redundancy, special contiguity and temporal contiguity. The coherence principle states that elimination of interesting, but extraneous words, pictures and sounds can help learners learn better since processing non-essential information can divert essential processing functions. The use of signaling, or cues to highlight organization and important information can be used to guide learner processing away from extraneous information and to essential information. Mayer (2009) does note that verbal signaling is effective, whereas visual signaling is not and that too much signaling was detrimental to learning. The redundancy principle postulates that graphics and narration are more effective for learning than graphics, narration and text. The duplication of information in text format was found to be detrimental to learning as if results in cognitive overload. The spatial contiguity suggests that words and pictures should be closely associated with each other when presented in a multimedia format in order to reduce learner cognitive processing. The close association of the words and pictures creates the relationship for the learner, leaving their cognitive processes available for essential learning. Similarly, the temporal contiguity principle suggests that words and pictures should be displayed at the same time, rather than at different times.

The second set of principles addresses the need to manage essential processing by presenting material in a pace and level of complexity that is appropriate to enable the learner to move the information into working memory. These principles include segmenting, pre-training, and modality. Mayer (2009) suggests that for complex material it is more effective for learning to have the material broken up into smaller segments and to have these segments be under learner control. This allows the learner to grasp the concept in manageable sections before proceeding to the next concept. The second principle for essential processing is pre-training, which provides the learner with key information (names, definitions, etc.) before the concept is presented. This prevents cognitive overload by providing the learner with fundamental knowledge prior to the complex concept so that it can be processed independently, instead of being processed at the same time. The modality principle suggests that pictures and spoken word are more effective for learning than pictures and text. This principle reduces cognitive overload by dividing material into two channels, auditory and visual, instead of presenting both in the visual channel.

The final set of principles for multimedia design proposed by Mayer (2009) are intended to foster generative processing, or the organization and integration of the material into long-term memory. These principles include the multimedia, personalization, voice and image principles. The multimedia principle as described by Mayer (2009) states that learners learn better from text and pictures than from only text. Presenting material with both text and pictures encourages the construction of verbal and visual mental models to assist with generative processing. The personalization principle advises a conversational style for presentation to encourage a sense of participation in a conversation rather than instruction. The voice principle finds that human voices are more effective than machine generated voices, and the image principle found no strong evidence that an instructor's image increased generative processing.

This theory for multimedia learning does not take into account motivation for multimedia learning. However, Mayer (2014) has recently acknowledged that here is a role for motivational aids in fostering generative processing, with the caveat that these aids not overload the learner's essential cognitive processes. These motivational aids might include appealing images or challenging learning situations.

Accessibility

One significant issue with audio tours is the lack of accessibility for visitors from different cultures or with disabilities. Giusti (2008) states that museums must provide " resources and technologies that acknowledge various cultures and abilities" in order to attract and retain visitors. She claims that handheld technologies can empower a variety of users and provide greater accessibility for all.

Although useful for visitors with visual disabilities, visitors with hearing or motor disabilities will have little or no use for audio tours. Ruiz, Pajares, Utray, and Moreno (2011), studying electronic tours for maximum accessibility have recommended that all audio in multimedia should include subtitles as well as signed tracks. Giusti (2008) notes the success of a handheld multimedia tour produced in American Sign Language for a 2006 exhibit at Boston's Museum of Science. She states that the 22-stop guided tour was well-received by deaf visitors as they appreciated the flexibility, depth of information and self-pacing the tour provided. She does warn however, that as multimedia and audio tours can increase the length of time visitors spend looking at exhibits while processing the audio information, deaf users must spend this time focusing on the handheld device to either read captions or view the sign-language tour instead of at the exhibit or object.

Ruiz et al. (2011), suggest that to assist visitors with visual disabilities options for audio description of exhibits should be included, as well as navigation information and magnification options for text. Giusti (2008) concurs, noting that detailed descriptions of objects and exhibits should be included in audio tours to assist those with visual disabilities gain greater understanding and appreciation. In addition, she states that wayfinding information is particularly valuable for tours created to assist blind visitors.

In terms of design for handheld devices, Ruiz et al. (2011), suggest that all options for special configurations for handheld devices to assist users with disabilities should have a central location to allow ease of device personalization and configuration.

Theory and Conceptual Framework

The Theory of Reasoned Action (TRA), developed by Fishbein and Ajzen (1975) from a social psychological approach, bases user behavior on behavioral intention. This behavioral intention is influenced by both attitudes and subjective norms. The theory postulates that attitude

results from belief about consequences of actions, whereas subjective norms result from beliefs about what others believe is correct or incorrect behavior.

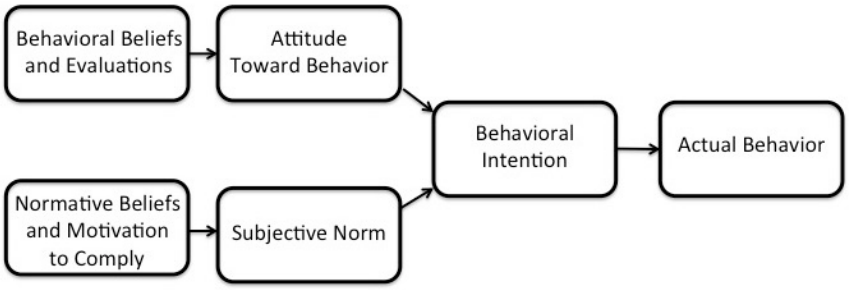

Figure 6. Theory of Reasoned Action (Fishbein & Ajzen, 1975)

The Theory of Reasoned Action has been used to develop the conceptual framework, the Technology Acceptance Model (TAM), used to examine technology acceptance and use. The TAM examines a user's perceived usefulness and perceived ease of use of a specific technology to determine attitude toward use. Attitude toward use then leads to behavioral intention to use, and eventually actual system use. Perceived usefulness can also affect behavioral intention to use, and perceived ease of use can affect perceived usefulness. External variables can also be found to affect both perceived usefulness and perceived ease of use.

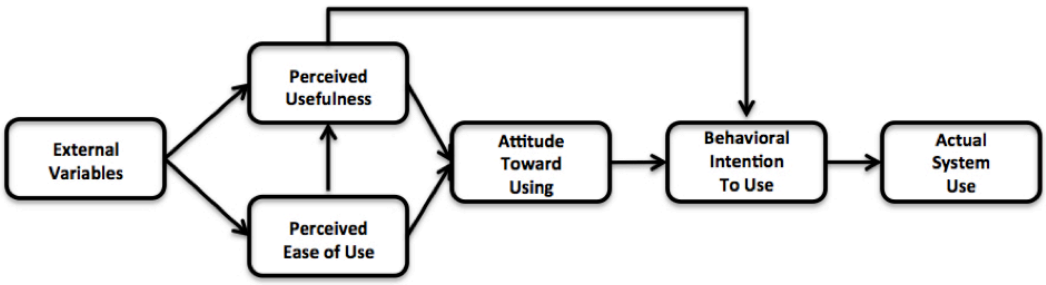

Figure 7. Technology Acceptance Model (Davis, 1989)

The TAM has been used extensively for examination and explanation for technology acceptance, but primarily in a capacity where usefulness is defined by job performance or task completion. Few research studies have applied the TAM to an informal learning environment where perceived usefulness might be translated into perceived value or enjoyment.

Extended or alternate versions of the TAM have been developed to address perceived criticism of the model. These versions include TAM2 (Venkatesh & Davis, 2000) and the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, Morris, Davis, & Davis, 2003). Although these models and others have been proposed as alternatives to the TAM, none have been universally accepted as a replacement for the TAM.

University of Hawai‘i Mānoa College of Education Site

The College of Education on the University of Hawai‘i Mānoa campus is a leading force in education in Hawai‘i and it has a long and rich history. With the only nationally accredited teacher education programs in Hawai‘i, the College of Education (COE) produces more than 65% of the state’s teaching force, as estimated by the Hawai‘i Department of Education. It offers 23 degrees and specializations and consistently ranks among the top 50 graduate schools in education in *U.S. News and World Report*. The College goes beyond Oahu to support neighbor island educational programs and produces more educational leaders and teachers than all other education programs in the state combined ("Currents," 2013). With roots in the Honolulu Normal and Training School, formed in 1896, later renamed the Territorial Normal School after Hawai‘i’s annexation, the College of Education has been a leader in furthering the field of education in Hawai‘i for over 100 years.

In 1930 the Territorial Normal School, extant since 1895, constructed the Teachers College Building on the site, on the outskirts of the existing University campus. This building, now known as Wist Hall, is “the only building on campus designed by the noted island architect, the late C.W. Dickey” (Kobayashi, 1983, p. 50). Another building, now known as Wist Hall Annex 1, was built the same year as part of the Territorial Normal School and in 1931 the Territorial Normal School was merged with the University’s School of Education to become Teacher’s College, responsible for educating all elementary and secondary teachers and requiring a Bachelor’s degree for certification. The University Elementary School building was constructed soon after in 1939, and in 1941 Castle Memorial Hall was built on the site through a gift from the Samuel and Mary Castle Foundation for the Castle Memorial Kindergarten. Honolulu Architect Mark Potter designed Castle Memorial Hall specifically for educating young children with “ramps leading to fenced-in play yards with large trees, a wading pool and sandbox” (Kobayashi, 1983, p. 78).

In 2005 the College of Education's University Elementary School building burned to the ground. Not only was an important historical piece of the University's history completely lost, but also lost was valuable classroom and office space. Currently, plans are in place to replace the University Elementary School building with a permanent building and to renovate the College of Education site to provide additional office and classroom space. As part of this planned renovation, two of the historical buildings, University High School Buildings 1 and 2 are planned for demolition and the current layout of the site will be considerably altered.

As the landscape of the site changes, a multimedia mobile tour can provide a way to preserve the history of the site for visitors and allow a comparison of the past landscape to the new and evolving one. It is a critical time for such a project as there is limited time for documentation of the existing landscape before renovations are scheduled to begin and this valuable historical information is lost.

CHAPTER 3. METHODOLOGY

The purpose of this qualitative design case study was to determine the design elements that lead to technology acceptance for learning with mobile multimedia tours at an informal historical site. The study attempts to discern how to provide interpretive information to visitors through mobile multimedia in a way that will lead to general adoption of the technology. The results of this study should also lead to development of general design guidelines that will enhance visitor engagement for mobile multimedia tours. It is intended that these guidelines can be used by a variety of museum environments to develop effective and engaging multimedia tours.

Research Design

This research study uses a design case study methodology paired with a design and development research approach for prototype design. The design case study examined the implementation of the mobile multimedia historical tour. Design and development research guided the creation of the prototype that was used for participant testing.

Case Study Research

The research methodology for this study is a qualitative design case study. According to Yin (2013) a case study "investigates a contemporary phenomenon in depth and within its real-world context" (p. 16). This project is an in-depth examination of design elements for a multimedia mobile tour within an outdoor historical site context. Yin (2013) also states that case studies rely on direct observation and interviews as sources of evidence. This study uses both of these methods for data collection. Additionally, one significant aspect of a case study that differentiates it from an experiment is the lack of control over behavior (Yin, 2013). This study was conducted in a real-world context where there was no ability to control visitor or user behavior or actions. Yin (2013) also notes that questions applicable to case study research are often 'how' and 'why' questions. Both research questions for this study can be classified as 'how' questions.

Case study research does have limitations and there are concerns raised over the rigor of this methodology. However Yin (2013) states that rigor in case studies can be enhanced by following “systemeatic proceedures” and keeping “equivocal evidence” from influencing “the direction of findings and conclusions” (pp. 19-20).

The ultimate goal for this study was to develop design guidelines for mobile multimedia tours. However, as Yin (2013, p. 41) notes, analytic generalizing from case study research relies on the application of a theory or framework. It “may be based on either (a) corroborating, modifying, rejecting, or otherwise advancing theoretical concepts” referenced in the design of the case study“ or (b) new concepts ”arising after completion" (Yin, 2013, p. 41). This study relies on both theory and a framework that are detailed in the study design, and the generalizations from this case study approach are intended to apply directly to them.

Design and Development Research

The multimedia mobile tour was developed as part of the study, thus the study consisted of two phases, development and testing. The study used a design and development research approach. Richey and Klein (2005) identify research studies focused on identifying general development principles from an “instructional product, program, process, or tool” (p. 24) as Type I developmental research. They find these studies are often structured in phases, including phases of “prototype development and testing” as well as “prototype revision and retesting (Richey & Klein, 2005, p. 26).” Richey and Klein (2005) acknowledge that a case study methodology is often used for Type I research studies for design and development and for evaluation.

Prototype development for this project consisted of two phases (see Chapter 1, Figure 2). The first phase used rapid prototyping to develop an initial prototype. Rapid prototyping was selected as a method for development since it is an iterative, flexible process that can lead to agile development. To aid in this process, two technical experts were selected to assist with evaluation. These experts were recruited based on their expertise with information technology, mobile technologies, mobile tours or Website development. One of these experts was a faculty member within the College of Education. The other was a staff member with the University of Hawai‘i’s Information Technology Services. The experts were consulted at different stages of development for advice and recommendations on design implementation. They also participated

in informal interviews to discuss identified technical and design problems. This process of consultation occurred multiple times throughout the rapid prototyping process. The initial prototype was considered ready for release once the researcher felt that all technical issues were satisfactorily resolved.

The second phase began after the release of the initial prototype. This phase was evaluation of the audio tour copy by two content experts. Both experts were recruited from current or retired College of Education faculty with knowledge of the history of the College. These experts evaluated the audio tour from an historical standpoint. The content experts identified historical errors and provided suggestions for alternate wording. Revisions were made based on this input and COE Tour V1.0 was tested with participants.

After COE Tour V1.0 was tested by participants, further revisions were made to the tour based on findings from the testing. Technical and design issues were identified and revisions were implemented based on these findings. Again, technical experts were consulted for design and technical recommendations. Once the researcher felt that all technical issues were satisfactorily resolved the revised tour was released as COE Tour V2.0 and participants were asked to evaluate this revised tour.

Research Questions

This project explored how design elements can affect user adoption of a mobile multimedia tour. Using the Technology Acceptance Model (TAM) as a conceptual framework, the research questions relate directly to the TAM. Both questions address adoption of the multimedia mobile tour by focusing on perceived ease of use and perceived usefulness of the technology, aspects of the TAM that affect attitude toward using, which eventually leads to actual system use. Both perceived ease of use and perceived usefulness are addressed through a design perspective. The research questions are:

RQ1. How can design elements affect user value/enjoyment of a multimedia tour?

RQ2. How can design elements affect ease of use of a multimedia tour?

Conceptual Framework

This project uses the Technology Acceptance Model (TAM) to examine what factors can affect acceptance of the multimedia tour. The Technology Acceptance Model, as developed by

Davis (1989), is based on the Theory of Reasoned Action (Fishbein & Ajzen, 1975). This framework was further discussed in Chapters 1 and 2.

Participants and Context

Participants

This project used purposeful sampling to recruit participants for two phases of testing. All participants were over age 18. Participants were individuals without extensive knowledge of the College of Education history, but with an interest in the history of the College, the University of Hawai‘i or historical sites. They were, in effect, considered the visitors or learners that would typically use such multimedia mobile tours. Richey and Klein (2005) identify learners as one of the types of participants commonly used for product evaluation in Type 1 design and development studies. Carr-Chellman and Savoy (2004, p. 701) note the importance of including users in the process of design research. They state that if innovations are not designed with user input it can lead to “innovations being less than acceptable or usable.”

Three participants with significant experience with mobile technologies were recruited for the first phase of evaluation. Selecting participants with experience using mobile technologies or ‘Super Users’ allowed for prototype testing by individuals that have foundational knowledge in mobile apps and device functionality. Data collection from these individuals provided feedback on features and functionality that would have been problematic from the standpoint of expert users or according to Cooper (1999), “apologists.” Problems reported by this first phase of participant testing were addressed and the prototype revised before the second phase of testing commenced.

For the second phase of evaluation, participants were not required to have any knowledge or experience with mobile devices. Ten participants were recruited for this phase of testing. This final phase of testing tested the prototype with the intended audience, users from a variety of educational backgrounds, ages, technical expertise and interests with no particular knowledge or experience with mobile technologies. These mainstream users or “survivors”, according to Cooper (1999), provided the real-world testing to provide valuable insight into the functionality of the prototype.

The total number of participants for both phases of testing was thirteen. Creswell (2002) suggests a minimum of 3-5 participants for case-study research, so the projected number of

participants for this study exceeded the suggested minimum. The number of participants is also seen as reasonable and not too large for "deep, case-oriented analysis" (Sandelowski, 1995, p. 179).

IRB permission and consent was obtained for this project through the University of Hawai'i Human Studies Program. Data collected for this project was kept in a secure physical location or on a password-protected and encrypted computer. Portions of the audio recordings for the interviews were transcribed and the recordings will be erased at the completion of the project. Pseudonyms were used in all discussions and reports of findings to ensure participant privacy and confidentiality.

All participants were presented with a consent form at the start of testing. The consent form stated that participation in the study was completely voluntary and that participants could withdraw from the study at any time. Participants were also informed that there was no identifiable risk for participation in this study, but that their participation in this study may help provide valuable information to organizations and institutions creating such tours. All participants were required to sign the consent form, and indicate their consent for the audio recording for interviews. These consent forms were retained by the researcher in a secure environment with other physical data collected for the project.

Study Setting

Testing for this project was conducted at the College of Education (COE) on the University of Hawai'i Mānoa campus, and COE buildings and landscape were the subject of a multimedia mobile tour. The buildings on the site of the current College of Education were some of the first buildings constructed on the University of Hawai'i Mānoa campus and they are a significant piece of the history of the University and the history of education in Hawai'i. Some of these buildings on the College of Education campus date from the 1930s. The oldest, Wist Hall, was built in 1931 as the Teachers College Building, part of the Territorial Normal School. Construction of Wist Hall Annex 1 and the University Elementary School building soon followed. In 2005, the University Elementary School, a structure used for education of Hawai'i's children since its construction in 1939 burned to the ground and a valuable piece of the University's history was lost.

Currently, the College of Education site is under analysis for major renovation. Plans include the demolition of University High School buildings 1 and 2, constructed in the 1940s, and renovation of Castle Memorial Hall, constructed in 1941. In addition, construction of a new building to replace the University Elementary School building lost in 2005 is being planned. As these changes are implemented the structure of the site will be dramatically different, therefore this was an optimal time to record the College of Education site as it stands today.

For this study, a multimedia mobile tour of the College of Education site and historic buildings was developed and participants were asked to experience the tour at the site. Participants were provided with a Kindle Fire tablet for the tour and they were asked to spend at least twenty minutes at the site engaging with the tour. The tour was available at times convenient for participants and scheduled in advance with the researcher. Participants were expected to walk over even terrain on paved pathways and grass. The tour was conducted outdoors during daylight hours.

Treatment

This study involved creating and testing a mobile multimedia tour for an outdoor historical site. Using the College of Education buildings as an informal, outdoor historical site, the mobile tour provided historical photographs, video and text information for visitors. Wayfinding and mapping were also provided through the tour.

To design a tour that was both engaging and effective for learning, development of the multimedia tour was based on established theories of multimedia design and instruction. Design of the multimedia elements for the tour were based in Mayer's Cognitive Theory of Multimedia Learning (Mayer, 2009) and followed his principles for reducing extraneous processing, managing essential processing and fostering generative processing. In addition, design incorporated Merrill's first principles of instruction, including activation, demonstration, application and integration (Merrill, 2008).

The College of Education buildings currently have no signage or posted historical information, so visitors had to rely solely on the mobile tour to provide historical context. The tour was tablet based and presented as a Web application. The devices initially used the University of Hawai‘i wireless network for access to the tour, but due to inconsistencies with the

wireless network connection a mobile hot spot was used for the second round of participant testing.

Instrumentation and Procedures

For the testing phase, participant surveys were created and disseminated through Google Forms. These online surveys consisted of five demographic questions and twelve questions related to the two research questions.

Table 1. Survey Questions

Question	Style	Data Collected
1. Name	Text	Demographic
2. Gender	Multiple Choice	Demographic
3. Age	Multiple Choice	Demographic
4. College of Education affiliation	Multiple Choice	Demographic
5. I feel ____ using mobile technology (smartphones, tablets, etc.)	Likert Scale	Demographic
6. I enjoyed this multimedia tour	Likert Scale	Research Question 1
7. The part of the tour I enjoyed the most was:	Multiple Choice	Research Question 1
8. The part of the tour I enjoyed the least was:	Multiple Choice	Research Question 1
9. The content of the tour was interesting to me	Likert Scale	Research Question 1
10. This tour increased my knowledge of the College of Education's history.	Likert Scale	Research Question 1
11. This tour increased my appreciation of College of Education	Likert Scale	Research Question 1
12. The tour was easy to use	Likert Scale	Research Question 2
13. I would recommend this tour to others	Likert Scale	Research Question 1
14. What were the most enjoyable aspects of the tour?	Text	Research Question 1
15. Were there any aspects of the tour that were confusing or too complicated? If so, please describe.	Text	Research Question 2
16. Please comment on aspects of the tour that need improvement.	Text	Research Question 2
17. Are there any other comments you would like to add about the tour and your experience with it?	Text	Research Questions 1 & 2

These seventeen questions consisted of one text question, seven Likert scale questions, five multiple-choice questions and four open-ended questions. Table 1 shows the survey questions and their relevance to the data collected for the study. Richey and Klein (2005) note that surveys are an appropriate choice for product evaluation in Type 1 design and development research studies. Savenye (2014, p. 263) states that in informal learning environments surveys are relied on heavily to "measure aspects of learners' attitudes, and other affective variables, such as interest, excitement, intentions, and motivation."

Direct observation of participants in Phase 2 of testing was recorded using traditional note taking with pen and paper. Since the observations were recorded outside while following participants on the tour it was easier to write observations than to use a laptop or tablet to type observations.

Semi-structured interviews with participants were conducted within two weeks of participant completion of the tour.

Table 2. Semi-Structured Interview Questions

Question	Research Question Addressed
1. Please give your overall evaluation of the design of the multimedia tour.	RQ1 & RQ2
2. What was the most enjoyable feature of the tour? Why?	RQ1
3. Were there any technical complications that diminished your enjoyment of the tour? Please describe them.	RQ1 & RQ2
4. Would your level of enjoyment at using the tour be the same if it was used away from the site? Why or why not?	RQ1
5. What feature did you like least about the tour?	RQ1
6. What would increase your enjoyment of the tour?	RQ1

Table 2 shows the questions for the semi-structured interviews and the research questions addressed. The participant's survey was analyzed prior to the interview. Based on this analysis, some questions were altered to explore additional themes that appeared in the participant's survey. Richey and Klein (2005) note that interviews are an appropriate method for Type 1 design and development research studies. Savenye (2014) states interviews in informal learning environments can be conducted either individually or in groups and that they can be either structured or unstructured.

Data Collection

Data collection began after revisions to the prototype were made based on the input from the technical and content evaluation. At this point the prototype was considered ready for release. Data collection consisted of two phases. The first phase tested the overall design with three participants with experience using mobile devices, the Super User group. The second phase tested the prototype with ten participants with no explicit experience with mobile technologies.

Phase 1 Testing

Participants in Phase 1 testing were expected to test the mobile device technology more rigorously than participants less experienced with mobile technologies. These participants had more experience with mobile devices and applications; therefore, they were able to identify and articulate any problems with the mobile technology aspect of the prototype. These participants were also able to provide suggestions for improvement based on their experience with other apps or mobile devices.

Phase 1 participants experienced the tour for a minimum of 20 minutes. During the tour the researcher was available to address major problems, but these participants were not observed during the tour. Upon completion of the tour participants completed the online survey of seventeen questions. Participants were provided with a URL for the survey to complete and submit online. Participants were encouraged to submit the survey immediately after completion of the tour, and all did so. Participant surveys were analyzed and themes identified for follow-up discussion.

Within two weeks of survey completion, semi-structured interviews were scheduled with participants. Interviews were conducted at the College of Education and were less than 60 minutes in duration. There were six questions for each interview.

All interviews were conducted face-to-face. These interviews explored the themes identified in the surveys. Interviews were audio recorded through a digital voice recorder for later transcription. Interviews were transcribed in entirety for analysis. All Phase 1 participants participated in the semi-structured interviews.

Phase 2 Testing

The second phase of data collection involved ten participants with no requirements for existing knowledge or experience with mobile devices. This group of participants was intended to most closely match the typical audience of a museum multimedia tour as there would be a wide distribution of technological experience, age, interests and experience with audio or multimedia tours.

Phase 2 participants also were asked to use the COE Tour V1.0 for a minimum of 20 minutes on site. The researcher observed some of these participants, and some completed the tour without researcher observation. The mix of observed and non-observed participants provided rich information on problems and experiences for participants. Upon completion of the tour participants completed the online survey of seventeen questions. Participants were provided with a URL for the form to complete and submit online. Participants were encouraged to complete the survey immediately after completion of the tour, and were provided with a computer to do so.

After data from the surveys and observations was analyzed, specific participants were asked to engage in semi-structured interviews with the researcher. There were five interviews conducted with Phase 2 participants. Participants were selected for interviews based on their availability and interest in participating. These interviews explored the themes identified in the surveys and/or observations. Interviews were conducted at the College of Education and were less than 60 minutes in duration. There were approximately six questions for each interview. The interviews were all conducted face-to-face. Interviews were audio recorded through a digital voice recorder. Interviews were transcribed in entirety for analysis.

Revised Tour Testing

Based on the findings from Phase 1 and Phase 2 testing, revisions were made to the COE Tour to refine the design. Once these revisions were made, the eight participants that had participated in interviews during Phase 1 and Phase 2 testing were asked to review the revised design and complete a survey. The survey consisted of 14 questions to clarify opinions on COE Tour V1.0 and to evaluate responses to COE Tour V2.0. This survey consisted of four open-ended or text-based questions, four multiple-choice questions, and six Likert Scale questions.

Data Management

Data for this study was collected in a variety of formats. Survey data was collected through Google Forms into a spreadsheet. Observation notes were collected using pen and paper. Interview data was audio recorded, and notes were taken during the interviews. The audio recordings of all interviews were transcribed for coding and analysis. Downloaded versions of the spreadsheets were retained on an encrypted computer and printed copies were kept in a locked office.

Initial Analysis

Initial data analysis examined the participant responses from surveys, observations and interviews to identify the predominant themes related to the prototype design. Throughout the initial coding process the researcher kept analytic memos. These memos ensured that all nuances of the analysis were being noted and cited. The memos also served as "an additional code- and category-generating method" (Saldaña, 2013, p. 51) by providing a platform for brainstorming and collection of outlying codes. Analytic memos were kept in notebooks.

Higher Level Analysis

For this stage of analysis both values coding and evaluation coding were used. Saldaña (2013) states that values coding is particularly appropriate for case studies and can be used for interview transcripts and observation notes. He notes that using values coding can corroborate findings as it can be used to determine if a participant's statements mesh with observed actions. Values coding was used in this study to code the interviews and observation notes.

Saldaña (2013) describes evaluation coding as a method to assign merit or worth. Evaluation coding can be applied to survey data and be used to determine "what is working and

what is not" (Saldaña, 2013, p. 121). Survey data from this study was coded using evaluation coding to identify the design elements that are "working" and those that are not.

Analysis of the study data resulted in major themes regarding the design of the COE Tour V.1.0 and the revised tour, COE Tour V2.0. During the higher level analysis these themes were connected with the factors within the study's conceptual framework, the Technology Acceptance Model. Design elements that related to perceived usefulness and perceived ease of use were identified and categorized. General design guidelines were drawn from this categorization to provide the results for the study.

Validity

Yin (2013) discusses the use of triangulation for increasing construct validity for case studies. He states that using multiple data sources to corroborate findings will result in more accurate and convincing findings. He notes that true triangulation only occurs when findings are supported by multiple sources of evidence. Although Onwuegbuzie and Leech (2007, p. 237) claim that "a qualitative study cannot be assessed for validity," they do identify triangulation as one of the methods to be used to increase legitimation for qualitative studies. This study used multiple sources, interviews, surveys, and observation to triangulate the data and increase validity of the findings.

Onwuegbuzie and Leech (2007) also identify other strategies that can increase study credibility, including member checking, checking for researcher bias and ruling out spurious relations. For this study informal member checking occurred during the semi-structured interviews. The researcher confirmed initial themes from the surveys with participants during the semi-structured interviews. Checking for researcher bias was conducted by following suggestions by Onwuegbuzie and Leech (2007) such as "making the researcher's intentions clear," conducting the interviews at a neutral site and "using unobtrusive measures where possible" (p. 242). Peer checking of coding was performed to reduce the possibility of spurious relations.

Product

Conclusions for this study take the form of design guidelines to enhance adoption of mobile multimedia tours. Themes from the data have been used to identify the design elements that best enhance both perceived ease of use and perceived usefulness for the multimedia tour.

Summary

This qualitative design case research study examined a mobile multimedia tour for an outdoor historical site. The study took a design and development approach to focus on design elements for mobile multimedia tours that can lead to actual use and adoption of the technology. The results of this study lead to the identification of guidelines for design elements that best enhance learning and enjoyment for visitors in similar contexts. These guidelines will be of value to institutions planning to implement similar technologies.

CHAPTER 4. DESIGN CASE 1 – TOUR AND TEST

This chapter articulates the iterative design process, testing and results for the mobile tour. Design plans and decisions are discussed and the tour design is described. Testing of COE Tour V1.0 and the results of the survey and interviews are presented.

Design of COE Tour V1.0

Goals and Design Principles

In developing the tour, three primary goals were identified. One of the most important guiding principles of the College of Education (COE) tour design was to keep the tour simple and easy to use so as to minimize cognitive effort wasted on controlling the tour and accessing the content. It was felt that the tour should be intuitive for users to use, would fit with their mental model and would not waste cognitive effort on navigation or working with the interface. Audio tour wands, which have been highly successful, are basic in operation with few buttons and obvious functionality. The multimedia tour was intended to mimic this simple functionality, but add additional visual content. The result would be as easy to use as an audio tour wand, but would provide additional visual content to enhance visitor experience.

Secondly, the tour was to be created using free or low-cost DIY software. Taking into account the high expense of programming custom tours and the funding challenges facing many smaller leisure institutions, the intention was that the tour design could be easily and inexpensively recreated at other institutions, without requiring extensive programming knowledge, expertise or software. Successful design features would be identified that could be replicated easily in free or low-cost software.

Finally, the tour was to be designed to minimize distraction to enhance impact and engagement. The tour could not distract users from viewing the site and engaging with it. Based on Mayer's (2009) Cognitive Theory of Multimedia Learning the tour would be designed so that the visual channel would not be overloaded. To this end the tour was designed to be in essence an augmented audio tour. The audio commentary would be the primary driver for the transfer of information, with the on-site structures acting as the visual stimulation. To keep the visual

channel from being overloaded, the tablet-based visual content would be presented after the audio tour as supplemental information. As the design process progressed and participant reactions unfolded it became clear that this design choice was indeed flawed.

Technology: Affordances and Limitations

The first critical decision for the design was whether to create the tour as an app or a mobile Website. It was decided to create the tour as a Website to minimize the need for users to download and install an app, reducing problems with device compatibility. Also, some DIY Website software requires far less knowledge and fewer technical skills compared to DIY app builders. This would mean that development costs for institutions planning to develop similar tours would be low since they would not be required to pay high cost for programmers. Supporting the guiding principle for the tour design to be achieved without the need for expensive development costs, a low-cost or free DIY Website was selected as the development platform. On the downside, this would mean that devices would require network connectivity to access the tour and the design would have to fit within the constraints of the software flexibility, resulting in some limitations for design.

Wix (Wix.com) was chosen as the development platform for the tour. This DIY Website platform provided the ability to embed a variety of multimedia elements as well as a mobile version for compatibility with mobile devices. The DIY software was intuitive and easy to use. The unlimited plan with no ads, at a cost of $14 per month, was purchased for testing so that participants would not be distracted or confused by ads. Keeping true to the idea of a simple design while integrating different types of content and working within the constraints of a DIY Website builder was a considerable challenge. For example, there were limited options for audio player controls and for integrating audio tracks along with images. However, working within the confines of the DIY software the initial tour design did remain true to the design principles planned for the project and kept the cost for development low.

To ensure consistency in participant tour experience, a tablet was provided for all participants to use when viewing the tour. The tablet provided was a Kindle Fire tablet, also a low-cost investment ($79) compared to more expensive high-end tablet options.

Tour Content: Walking the College of Education

COE Tour V1.0 consists of six historic stops on the College of Education campus. The College of Education at the University of Hawai‘i at Mānoa is located on the Ewa or West side of the University of Hawai‘i Mānoa campus. The COE campus is enclosed by Metcalf Street to the North, Dole Street to the South, University Avenue to the East and Ho’onanea Street to the West. Buildings on the campus date from 1931 (Wist Hall), to the two new FROG (Flexible Response to Ongoing Growth) classrooms completed in 2016.

Figure 8. Aerial Photo of the University of Hawai‘i at Mānoa Campus (1932)

In a 1932 aerial photograph Wist Hall stands solitary on the COE campus. Today, a Google Maps image shows that this area is now filled with multiple structures housing classrooms and offices for the College of Education, its research unit the Curriculum Research and Development Group, the Department of Education’s charter School, The University Laboratory School, and the University of Hawai‘i at Mānoa Children’s Center, a preschool facility for University of Hawai‘i faculty, staff and students.

Figure 9. Google Maps View of the COE Campus (2017)

The COE Tour V1.0 was designed to be an on-site walking tour. Each stop focuses on a particular building, or in the case of Stop 6, the site of a building that has been destroyed by fire. The six stops are: Wist Hall (1931), Castle Memorial Hall (1941), University High School Building 1 (1943), University High School Building 2 (1948), Everly Hall (1963) and Fire & the Future, the site of the University Elementary School Building (1939) and the FROG classrooms (2016). The stops are designed to be visited in chronological order to provide a comprehensive, chronological journey through the College of Education's history as seen through the history of the buildings on the site.

Design: The Virtual Guide

Designing a multimedia mobile tour to follow the guiding principles of the project to be engaging, simple and low-cost was a challenge. Starting with the concept of creating in essence, an augmented audio tour, I integrated design suggestions as found in relevant literature.

Following Nielsen's (2013) guidance, I kept the features to a minimum and made them easily visible with relevant icons. To enhance simplicity I followed Colborne's (2011) suggestions for simple design and organized items into sensible groupings and eliminated non-essential items for the supplemental visual features. I kept the interface controlled and consistent to match suggestions from Wilson (2011), all pages had the same colors and icons, with navigation placed in the same location. The tour content followed a coherent storyline in line with the recommendations from A. Lin et al. (2012) for creating enjoyable learning experiences. I also attempted to provide the user with choices for viewing the supplemental visual content as suggested by Gammon and Burch (2008) so that users would feel empowered to obtain information of interest to them. To reduce the possibility of creating user distraction through the technology, I followed recommendations by Filippini-Fantoni and Bowen (2008) and kept the content appropriate and limited.

COE Tour V1.0 begins with a simple landing page with a large arrow labeled 'Start.' The subsequent page contains brief information about the tour, including safety tips in both text and audio. The third page shows an image of the icons users would see on the tour with audio description. Each of these pages had only simple forward navigational arrows. The fourth page is the clickable tour map that is the primary driver for navigation in the tour.

Location markers indicate the location of each of the numbered stops. Clicking on the stop marker opens the page for that particular stop. A map icon on each page of the tour allows visitors to return to the map whenever needed to access other stops.

To help with orientation, the initial stop page consists of an image that the user sees when they are in the correct location for the stop. Each initial stop page contains audio commentary and icons linked to supplemental visual materials and the navigational map.

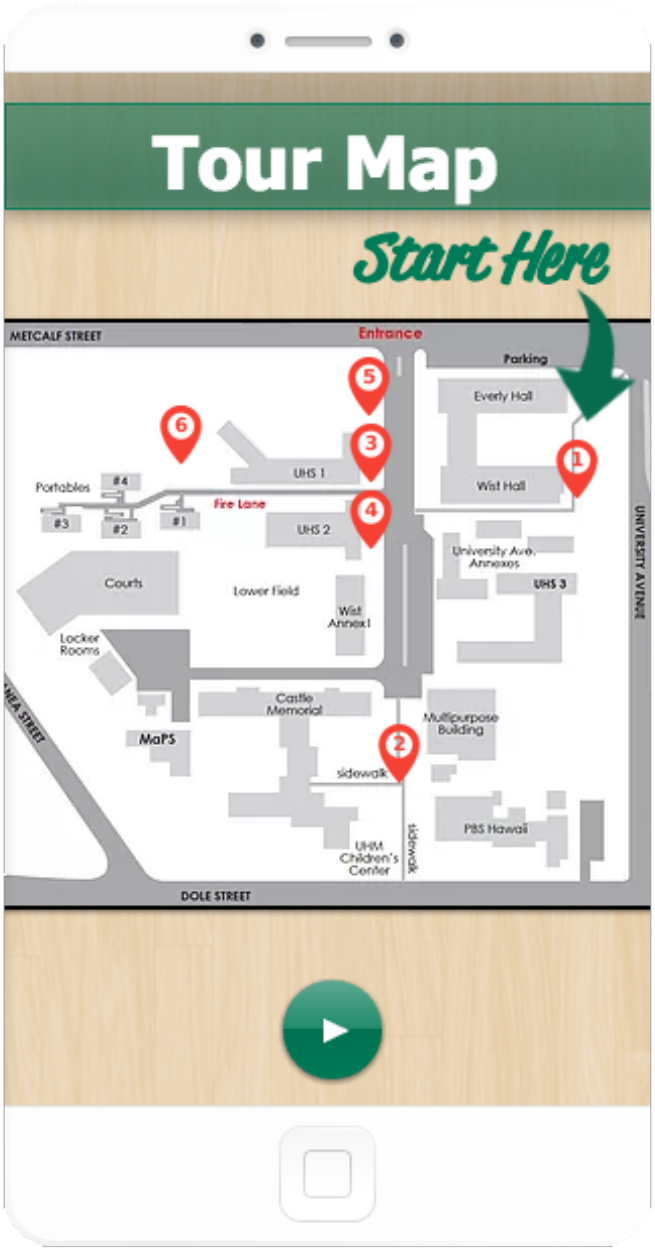

Figure 10. COE Tour V1.0 Map

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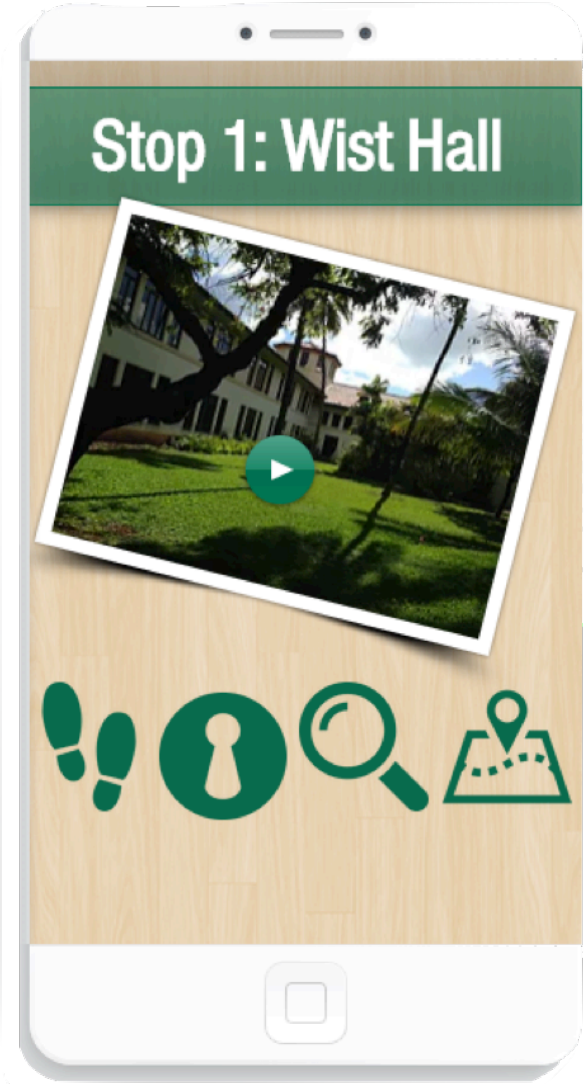


Figure 11. COE Tour V1.0 Stop Page for Wist Hall

The audio commentary is designed to last less than five minutes per stop and provides information on a range of topics to be of interest to visitors, covering architectural features, building history, current building usage, among other topics. Participants start the audio commentary by clicking the play button located on the center of the image on the initial stop page. The audio commentary for each stop concludes with a restatement of the meaning of each of the icons and instructions to return to the map page to find the next stop. The controls for the audio consist only of a play/pause button. To maintain the simplicity of design, additional controls such as rewind and fast forward were not included.

Design: Enhancing the User Experience

Supplemental visual materials fall into three categories: Peek Inside, Look Back, and Step Into the Past. Visitors access each of these features by clicking on an icon at the bottom of the initial stop page. The icon for Peek Inside is a keyhole, for Look Back, a magnifying glass, and for Step Into The Past, a set of footprints. The icons were chosen to clearly relate to the category and to be easily memorable. Once an icon is clicked the tour directs to a new page.

Peek Inside consists of current photos of the inside of the buildings. Since the tour is an exterior tour only, participants are only able to view the exterior of the buildings. The Peek Inside feature gives participants the ability to see what the building interior currently looks like.

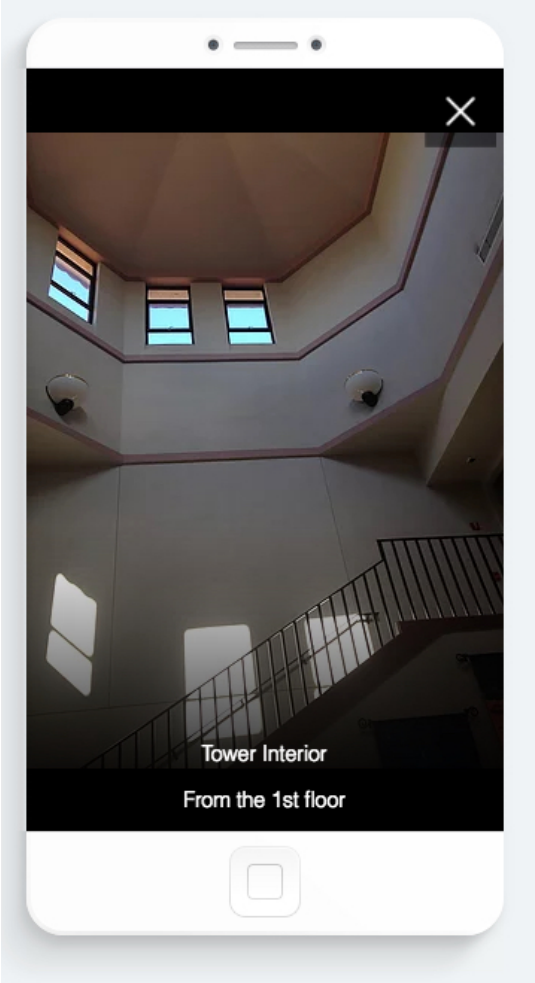


Figure 12. Interior of Wist Hall Tower from COE Tour V1.0

These current photos were included as a way to complete the viewers' experience with the structures. Since the tour was an exterior only tour it was expected that visitors would be interested and curious about how the buildings are currently being used. These photos would also allow interior views of some of the architectural features of the buildings, such as the unique Wist Hall tower.

Look Back includes historical photos of the buildings, including original building plans and photos of important related historical figures.

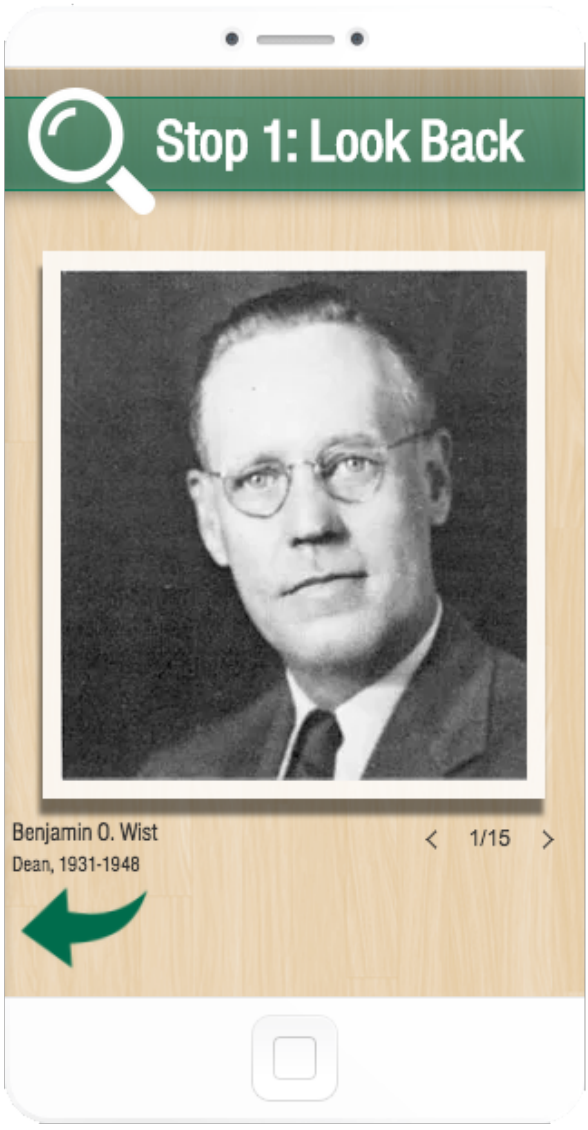


Figure 13. COE Tour V1.0 Look Back Page for Wist Hall

These historical images act as a way to bring the building history into focus for users. By seeing images of the individuals that shaped the COE and seeing scenes of everyday life through the long history of the COE visitors should connect more closely with the COE's history and form a greater appreciation for it. Walking the same paths and seeing the same sights as others from the past can create a greater bond with the site and a more intimate experience with it.

For both Peek Inside and Look back, a slideshow is available on the new page. Users are able to click through images at their own pace. Captions are provided under the photos for additional information. Clicking on the photo allows the photo to appear full-screen. The icon for the supplemental feature is repeated at the top of the new page to reinforce the connection between the icon and the feature it represents. A navigation arrow at the bottom of the page returns the user back to the initial stop page.

Step Into the Past is a feature intended to immerse the visitor into the past.

Figure 14. Step Into the Past Direction Page and Photo Page

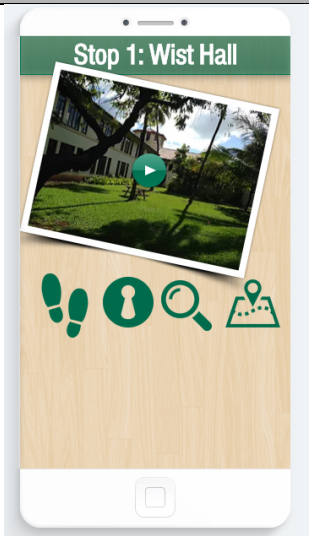
Directions are provided to direct visitors where to stand, then, after pressing a button on the tablet interface, they are presented with an historical photo matched to where they are currently standing.

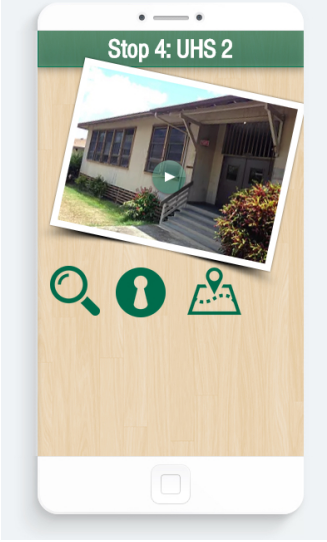
Audio commentary provides historical context for the photo. The intention for this feature is to provide visitors with a sense of augmented reality by providing an historical overlay for the current environment. They can step into the past through the tablet to see a snapshot of an event in the same spot many years ago. Each of the six stops has audio commentary and some or all of the supplementary features, depending on the available historical material.

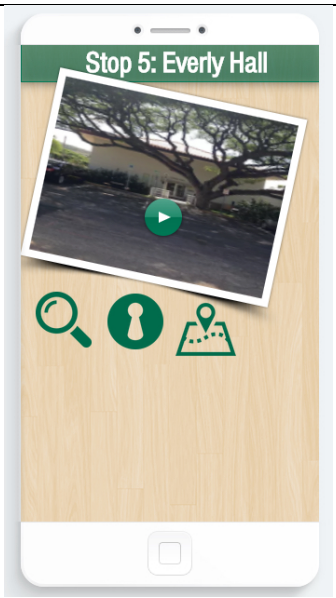
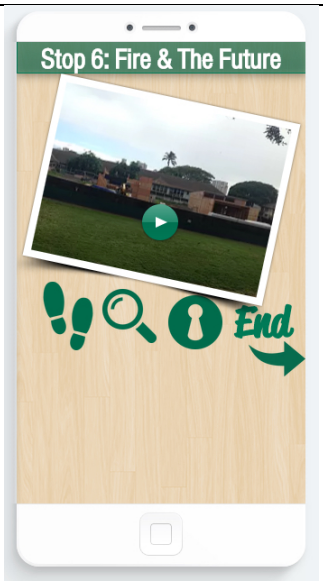
Figure 15. Visitor Viewing COE Tour V1.0 Step Into the Past Page for Wist Hall

All stops have the Peek Inside feature, although one stop (University High School Building 1) has a video for Peek Inside instead of still photos. The video was included to give users an alternate format for Peek Inside and to evaluate participant preference for video over still photos. All stops also had either the Look Back still historical photos or a Step Into the Past feature.

Table 3. COE Tour V1.0 Stop Pages and Features

Stop	Features	Stop Page
1: Wist Hall	• Step Into the Past • Look Back • Peek Inside	
2: Castle Memorial Hall	• Step Into the Past • Look Back • Peek Inside	

3: University High School 1	• Step Into the Past • Peek Inside (video)	
4:University High School 2	• Peek Inside • Look Back	

5: Everly Hall	• Look Back • Peek Inside	
6: Fire & the Future	• Step Into the Past • Look Back • Peek Inside	

Stop 6, the final stop, has an arrow labeled ‘End’ to direct users to the final page of the tour. This final page provides links for visitors to view the references for the tour, to submit COE stories and to submit questions about the COE.

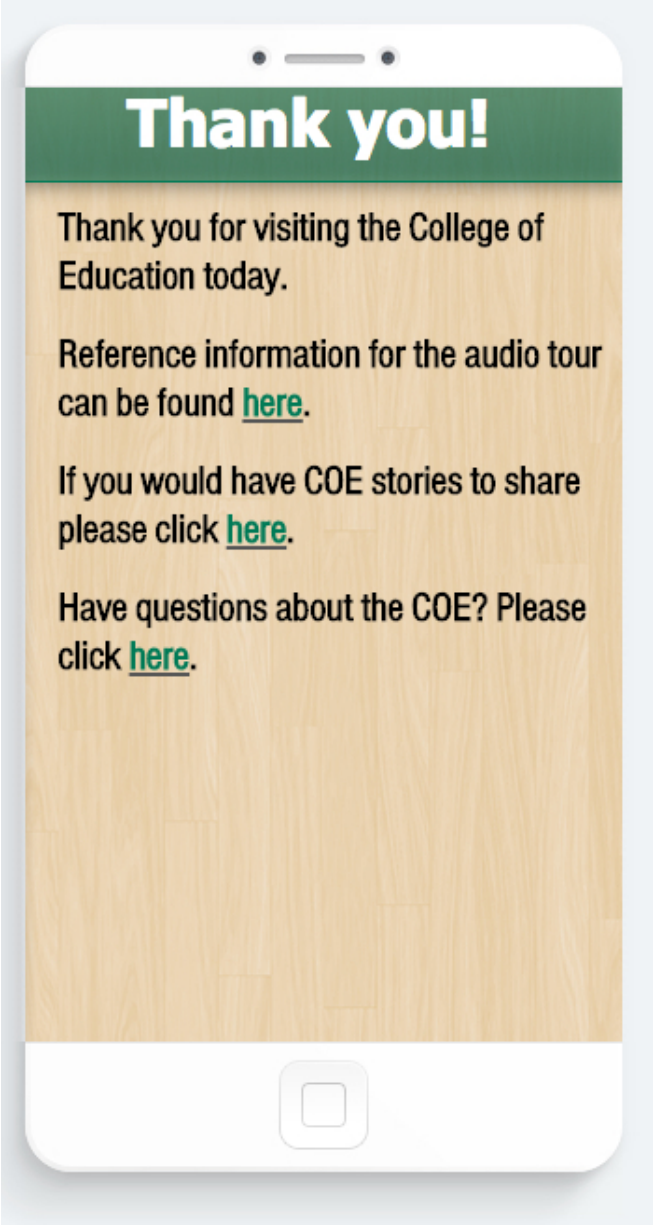


Figure 16. COE Tour V1.0 Look Back Page for Wist Hall

Design: Feedback and Help

Interface simplicity to enhance ease of use was a primary driver in the design of COE Tour V1.0. However, features were included in order to assist users in case they became confused during the tour. Icons were identified as the most likely area where users may experience difficulty. To combat this problem, the icons were clearly identified at the start of the tour. During the audio commentary the purpose of the icons was repeated. Additionally, a click

state was included so that users would be aware that they had clicked on the icon and that it was in the process of responding. Once clicked, the icon would display a text label to reinforce the association between the icon and the feature it represented.

COE Tour V1.0 Testing

Participants: Phase 1 and 2

As discussed in the methodology, the tour testing was conducted in two phases. The first phase of testing involved testing with a small group of 'Super Users.' These individuals were identified as having significant tech experience and would be able to identify and possibly even troubleshoot technical problems that might occur when doing the tour. This group included three participants: Fred, Coral and Gail. All three of these participants are current COE faculty/staff and current COE students. Fred is in the 45-54 age range. Coral and Gail are in the 35-44 age range. All three participants completed the tour successfully and completed both the survey and participated on one-on-one interviews.

Participants for the second group were selected as a convenience sample. It was hoped that this method of participant selection would provide a population similar to those that would normally take museum and audio tours and provide a range of user interests and technical ability. The users for the second group were Kate, Betty, Penny, Luke, Alex, Tina, Lara, Daniel, Shane and Melissa.

Including the Super User group, thirteen participants took the tour and completed the survey. All participants were asked to take the tour independently, but were asked to notify the researcher if they were unable to complete the tour due to technical problems. The researcher observed some participants while they took the tour, but did not offer assistance or guidance. Eight of the participants, including all three Super Users, were asked to engage in one-on-one interviews after they completed the survey. Participants, besides the Super Users, were selected for interview based on availability and interest.

Table 4. List of All Participants

Name	Gender	Age Range	COE Affiliation	Self-Reported Comfort Level Using Mobile Technologies
*Fred	Male	45-54 years old	Current COE Faculty/staff, Current COE student	Extremely Comfortable
*Coral	Female	35-44 years old	Current COE Faculty/staff, Current COE student	Extremely Comfortable
*Gail	Female	35-44 years old	Current COE Faculty/staff, Current COE student	Comfortable
Kate	Female	45-54 years old	No COE affiliation	Extremely Comfortable
Betty	Female	45-54 years old	Relative of current COE faculty, staff or student	Extremely Comfortable
Penny	Female	45-54 years old	COE Alumni	Comfortable
Luke	Male	45-54 years old	COE Alumni, Current COE Faculty/staff	Comfortable
Alex	Male	25-34 years old	COE Alumni, Current COE Faculty/staff	Comfortable
Tina	Female	35-44 years old	Current COE Faculty/staff	Extremely Comfortable
Lara	Female	25-34 years old	No COE affiliation	Comfortable
Daniel	Male	65-74 years old	Former COE faculty/staff	Extremely Uncomfortable
Shane	Male	35-44 years old	Current COE Faculty/staff	Extremely Uncomfortable
Melissa	Female	65-74 years old	Relative of current COE faculty, staff or student	Extremely Uncomfortable

* Super-User group

Eight females and five males participated in the COE Tour V1.0 testing. Most participants had some association with the College of Education, either as current or former faculty or staff, as current students or alumni, or relatives of current COE faculty or staff. Only two participants had no current association with the College. Participants were asked to identify all of their roles with the COE, therefore some participants appear in multiple categories.

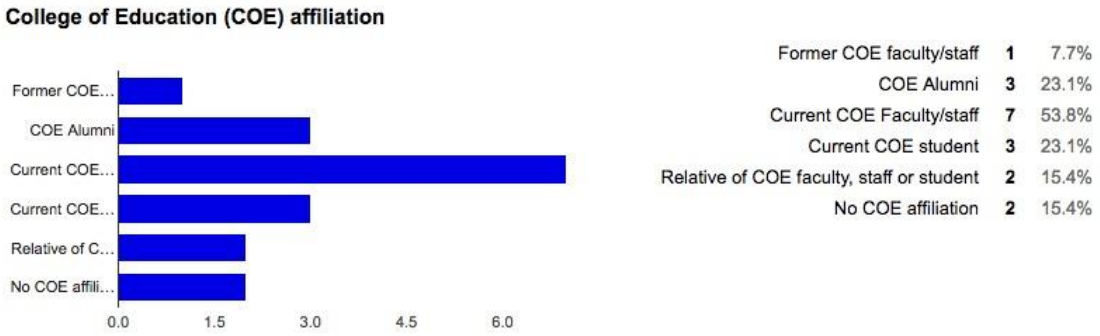


Figure 17. Participant Affiliation with the College of Education

Participants self reported perceived comfort level with technology. Three participants reported being extremely uncomfortable using mobile technologies such as tablets, smartphones, etc. These three participants were Melissa, a relative of a current COE faculty/staff, or student in the 65-74 age range, Daniel a former COE faculty/staff member also in the 65-74 age range, and Shane, a current COE faculty/staff member in the 35-44 age range.

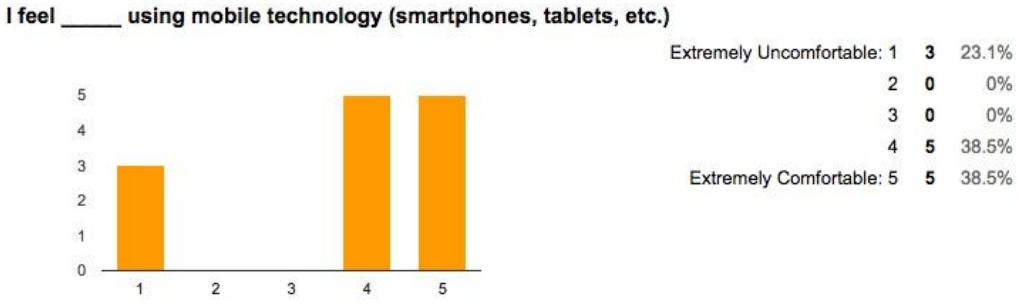


Figure 18. Participant Self Reported Comfort Level Using Mobile Technology

Ten participants rated themselves as either comfortable or extremely comfortable using mobile technology. In the Super User group, Fred and Coral self reported that they felt extremely comfortable using mobile technology, while Gail self reported feeling comfortable using mobile technology. The only non-Super User who self reported feeling extremely comfortable using

mobile technologies was Tina, a current COE faculty/staff member in the 35-44 age range. All other users self reported feeling comfortable using mobile technologies.

COE Tour V1.0 User Testing Results

Comments from the survey and the interviews fell into three main categories: user control, design and overall tour experience. Participant comments and quantitative data regarding these three categories are discussed in this section.

User Control

Participants in the tour voiced the desire for greater control over the tour. Alex stated clearly, “I feel as a user, I'd like to have more control over my own experiences with something like this.” Users reported this desire for control in areas of media control, content choice, content presentation and tour sequence.

Media Control. Participants cited control over the audio content as the most desired change in the design. COE Tour V1.0 had a single play button that would start playing the audio content for each stop. To maintain simplicity of design there were no additional controls to allow user control over the audio. This was partially a design decision, but also a limitation of the media player options available in the Wix software.

Participants strongly reacted to this design. They noted that they wished they had the ability to control the audio, either to repeat information or to skip forward through the audio commentary, as Luke stated, “It would be great if there was a way to stop/rewind the audio because at certain points, I wanted to reflect and re-hear what was said, but couldn't without having to listen to the recording from the beginning.” Participants also commented that they expected this feature to be available and were frustrated when they had to repeat the entire audio commentary for a stop instead of having control over the audio. Betty stated, “A couple of times I clicked on a different icon to look at something before the narration was complete and then I had to listen again to the length narration to get caught up. This was a bit frustrating”. Betty also noted the desire for a progress bar to indicate how much of the audio remained in the track, stating that she would have liked to be “able to know where I am in the audio track, being able to jump ahead in the audio track, jump back, too, or at least adjust some way.”

Some participants also stated that their expectations of how the audio would work was not in line with actual performance of the tour, as they expected that the audio would run in the background while they explored other features of the tour. They did not expect the audio to stop when they clicked on one of the icons or navigated back to the map, as Alex reported, "Doing the #1 tour, I inadvertently cut off the audio tour because I wanted to know what the other buttons do and where they would take me." Others stated that although it was not initially intuitive that the audio would stop, it made sense to them that it would once they navigated away from the audio tour page. Gail noted, "I clicked one of the buttons (look back, step inside, etc) while the audio tour was going and the audio tour stopped. (of course!)." In this respect, participant's mental model of the technology did not match with the performance.

Content Choice. Tour stops were designed to provide users with a short, but broad, multifaceted description of the historical structure. Each audio component included topics such as construction facts, history, social justice issues and architectural features. Although participants appreciated the range of information included in the audio component, they did voice a desire for greater choice in which information they wanted to hear. Tina stated her disinterest in the architectural information in the tour, "I am just not a person that's going to care about the louvers of a window or not, or a this or a that, but I think other people are. I think that's me personally being like, 'Right. I see a window.' That's unfortunately what I appreciate of architecture." Shane voiced similar lack of interest in the architectural information, stating that their lack of interest in the topic diminished his interest in the tour, "I did get distracted once the architectural components were discussed on the audio. I like architecture, but don't find any real interest in the style of the buildings presented."

Others suggested that users be provided the opportunity to choose which topics to explore. Penny asked, "I'm wondering if there would be a way to make it, even, a little more in depth, given a particular area of interest. For me, I'm not so interested in the architecture. Although, it's always nice to have things integrated, because then you can grow your interests in different areas." Penny suggested that an option be provided for users to take a deep dive into particular information of interest, "I like how it was. It might be nice to have that overview, as it is, and then, just have, maybe, in depth pieces following that."

Content Presentation. Participants expressed desire for more control over the presentation of the tour content. Some participants voiced a desire for text captioning of the

audio or an alternate text version based on their preference. Gail stated, “You know if you go to museums and whatever, and then they have an audio tour, generally I'm not very good with that medium. I feel like I need to see something on paper...retention-wise, I'm not going to retain the audio the same way that I would retain it if I read it.” Alex suggested that text, “should be there as an option for people who would like to use it, and they can hide it or show it at will.” However, Coral, a Super User, stated a preference for audio over text, “I felt like there was more of a connection hearing the audio portion versus having to read through it.”

In terms of media, participants voiced particular preferences for accessing the content with some self-identifying their optimal learning style. Alex stated, “if I had some of that supporting visuals at my option to view them or not, it would've helped me. I'm more of a visual learner.” Others had preferences for video presentation of content, as Gail noted, “The nice thing about having the video is you can have the audio with the stills. Whereas, if it was just stills, you're just stuck with whatever caption is there.” Kate disagreed, feeling that video did not allow enough flexibility, stating, “video can be a little slow panning through and whatnot. For a historical tour I like seeing the highlights in photos.”

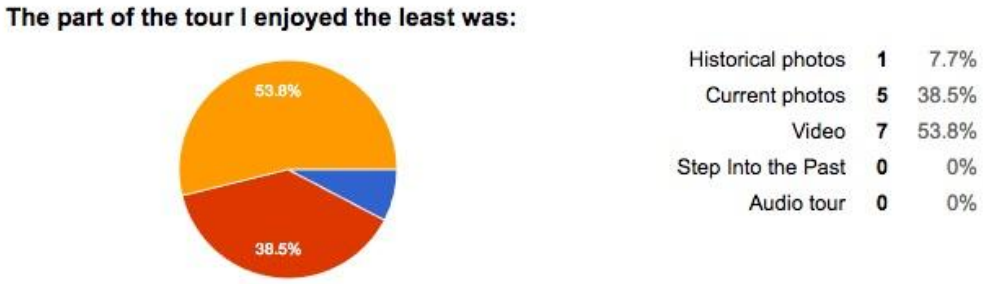


Figure 19. COE Tour V1.0 Least Enjoyable Feature

Participants found their least favorite parts of the tour were the video (53.8%). Current photos were found to be the least enjoyable aspect for 38.5% of participants. Of the participants that rated the current photos as their least favorite part of the tour, all, except Melissa, a relative of a COE faculty/staff member, were current or former COE faculty/staff that would have had some familiarity already with the interior of the buildings. 7.7% found the historical photos to be the least enjoyable. None of the participants found the Step Into The Past or the audio tour to be the least favorite features of the tour.

Sequence Choice. Participants voiced a desire to have choice over the sequence of tour stops. The tour was designed to move chronologically through the buildings on the College of Education campus. However, this did result in a sometimes circuitous path for the tour as buildings were not clustered in groups in terms of age. Although this was identified as the reason for the sequence of stops in the tour, many users did not appear to recognize this. As Kate stated, "I don't quite understand the order of the buildings visited on the tour -- it's obvious why Wist was first, but why Castle next, etc." Kate was also uncertain if the stops could be visited in alternate order. "some tours will say if you want to skip ahead, you could. Initially, I wasn't quite sure that I could skip around. Seeing number one, number two, number three I thought, 'Oh, I'd better go in order.' I wasn't positive that there was a reason for the numbering."

Other participants expressed their confusion and their desire to visit stops according to physical proximity. Tina stated, "The navigation of the tour, the location of the stops, I felt was a little disjointed. It's like if I'm standing outside of Wist, I don't know why I wouldn't look at Everly right then." Tina also suggested that the sequence of stops would be particularly confusing to those unfamiliar with the campus, stating, "The organization of the sites would have been confusing to me if I did not know the campus. To start at Wist and then go to Castle Hall and back again might be confusion. I would suggest changing the organization of the stops." Ultimately it appeared that participants would appreciate greater flexibility for the tour that would allow them greater choice in choosing the sequence of stops. As Alex stated, "I would more than likely, if the experiences are engaging, go through all of them, just not necessarily in order."

Tour Design

The tour was designed to be clear and easy to use for participants of all levels of technical proficiency. Participant responses on the design choices fell into four categories, interface design, icon design, amount of content and tour map and orientation

Interface. Participants responded positively to the overall interface design of the tour. They appreciated the simplicity of the design and stated that it was easy to understand the functionality. Shane described the interface as "clear and clean." Coral concurred, stating, "I like the design of the tour. I thought it was very simple" and Tina noted that the "Interface is easy." Appreciation of simplicity was noted by Betty who described how the simple design enhanced

ease of use, “Overall I liked the simplicity of the design. I was clear and easy to understand and fit the topic.” In terms of navigation Gail noted, “I think it looks pretty straightforward on the navigation.” Kate also noted that the interface was “pleasant to look at.”

In general, participants found the tour easy to use. 84.7% of participants agreed or strongly agreed that the tour was easy to use. None of the participants strongly disagreed or disagreed that the tour was easy to use. Interestingly, the two users that rated ease of use the lowest were Fred and Coral, two of the Super Users. This rating may be attributed to the difficulties the Super User participants experienced using the campus WiFi rather than the more reliable hot spot connection that was provided for the second group of participants. Discussion of the WiFi connectivity issue is discussed in further detail in the Tour Experience section.

The three users that self reported being extremely uncomfortable using mobile technology all found the tour to be easy to use. Melissa and Daniel agreed that the tour was easy to use and Shane strongly agreed that the tour was easy to use.

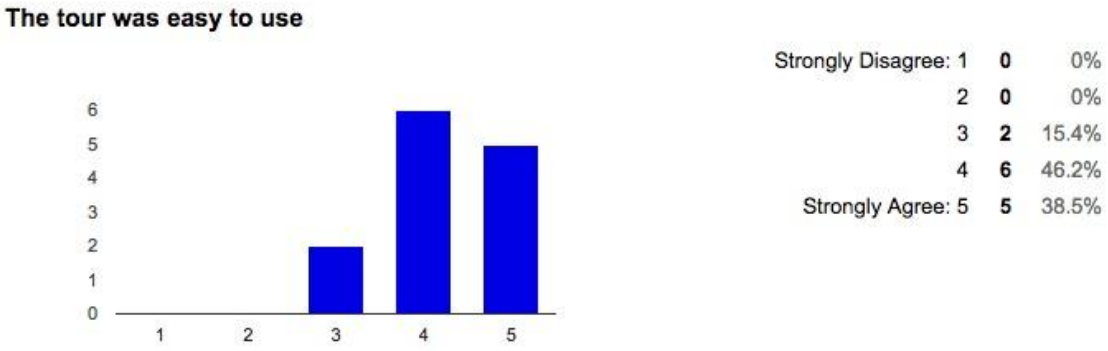


Figure 20. COE Tour V1.0 Ease of Use

Icons. Icons on the mobile tour directed users to different features (Peek Inside, Look Back, Step Into the Past and the map). For simplicity of design, icons were images only, no text was displayed to label the icons until they were clicked. Icons were introduced at the start of the tour and reinforced in the audio component of the tour. Some users felt the icons were well designed and easy to understand. Betty reported, “The icons were all great because I could easily click on them, they were very, very clear.” Others felt that they were not intuitive, and needed repeated use to remember icon functionality. Alex stated, “I felt that some of the elements were hard to intuitively understand what they did until you hit them one time.” Others agreed that icon

functionality took a while to understand and retain. Gail reported, “In the beginning I had ... I was like, "What is the difference between the step and the looking glass thing?" In the end I was like, Oh yeah, I get what the difference was between the 2 of them." Some participants noted that they explored the icons before hearing them described in the audio commentary. Alex stated, “I was wondering what the other buttons did. Instead of going to the end of your audio tour, which explained what those buttons did I noticed it I just jumped from that to the buttons.”

Some users voiced appreciation of the reinforcement of the icon functionality through the audio commentary. Betty reported, “Having the audio also say hey, this is the button you need for this, for that, all of those were great.” However, some participants stated that they never were able to remember which icon matched with which feature. Alex noted, “after a couple modules, I still couldn't remember which one did what until I clicked it.” He suggested that the icons include text descriptors or, “text overlay for buttons, describing their function.” Betty particularly appreciated the size of the icons, stating “the big buttons were great because I fat-finger things a lot. It was really nice to be able to move around.” She also expressed appreciation for the click state of the icons that indicated when the icon had been clicked, proving the user with feedback for their action.

Amount of Content. Participants generally felt that the number of supporting photos presented in the tour was an appropriate amount, as Penny stated, “The depth of information provided was a very comfortable depth... It was enough that it was worth listening to, but it wasn't like you felt like it was information overload.”

None of the users reported any areas where they felt there were too many photos, although some participants felt that they would have liked to see more photos. Betty stated, “I'm a huge geek, so I always want more, but I didn't feel like there was any area that was thin. I will always like more.” Douglas noted a desire for more historical content, stating, “additional commentary with historical photos would be a nice touch.” referring to the Step Into The Past sections where there was commentary with the historical photos. Luke expressed interest in more photos featuring individuals to enhance the historical content, stating “it would've been nice to see more people in both the past and current photos. It would add to the historical context.” Alex noted that he would have liked more photos for the Peek Inside sections which would allow a 360 degree view of the spaces, asking for ”more pictures for each peek-inside tour, maybe akin to a virtual you can do when looking for condominiums.”

Tour Map and Orientation. The tour map was the primary method for orientation for the tour. Fred found the map to be 'comprehensive' and Betty stated that the "navigation was very clear as was the map." Many participants cited difficulty with orientation based on the map alone. Some participants cited their inability to read maps as the problem, with Penny reporting, "I'm really particularly poor at reading maps. This is rather embarrassing to admit, but, I couldn't quite figure out." Betty was unfamiliar with the location and she stated, "I was having a little bit of a problem with orientation because I don't have my east-west here very well so I wasn't always sure what side I was on, and then trying to jump out and look at the map to see where I was, and I was back again." Participants familiar with the campus stated that they didn't have any problems with orientation, but they noted that their familiarity helped with orientation and voiced concern that orientation may be a problem for tour users unfamiliar with the campus. Tina noted, "If I'm doing it as a walking tour and I don't know the campus...then I would find it confusing." Gail voiced similar concerns, saying, "if you are completely new to campus, it might be difficult to find the spot you are supposed to be standing in." Coral voiced appreciation for audio cues to help with orientation, "the 'look towards your right, you'll see this' those kind of indicators were very helpful." Some users also had difficulty ensuring they were in the correct stop location. Coral voiced this concern by saying, "there was parts where I had to go back to the map to make sure I was in the right location."

Participants suggested a number of revisions to address confusion over orientation. Betty suggested noting a route on the map, "I think having a preferred pathway would have been nice." Lisa felt that including text directions could help with orientation, stating, "Written instructions on where to go next may also be helpful if people who are taking the tour are not familiar with the streets and buildings nearby to orient themselves by." Penny suggested including physical markers on the building to help direct participants to the correct location, expressing desire for "some kind of physical marker on the buildings, so I wasn't thinking, Okay. Am I on the corner of the correct building?"

Tour Experience

Several factors impacted the tour experience for participants. Participants commented on physical factors such as WiFi and sunlight as well as factors such as dramatization of the content,

the content itself, stimulation and interaction within the tour and the value of experiencing the tour at the site.

WiFi. The most critical factor to impact enjoyment and ease of use was the WiFi connection. The initial super users group used the campus wireless network for connectivity. These participants found frequent network lag and disconnection during the tour. Fred reported that it was frustrating to have the tour hang and "to be interrupted by "Oh, I got to wait, I got to wait. Wait, oh. I can't get in. I can't listen." As these participants were the super user group they did persevere and did recognize that the problem stemmed from the WiFi connection and were able to independently troubleshoot. Coral, one of the super users, for example, when faced with the connectivity disconnect was able to reconnect and continue with the tour without assistance, "I went back into the building to get connection to advance to the next part of the tour. Then it was okay after that." Since these super users were also COE staff they had the ability to enter the buildings for a stronger WiFi connection. However, as the tour was designed to be an exterior tour only, this would not be an option for other visitors. To address this critical situation, it was determined that the second group of participants would be provided with a wireless hot spot to provide stronger and more reliable connectivity.

Participants in the second group with the more reliable hot spot connectivity had fewer WiFi issues, but they did occasionally experience some lags. This did cause some confusion with some participants, causing them to question the tour performance. As Betty noted, "The WiFi was an issue since it worked very well sometimes and would stall others. This was a challenge at the start since I didn't know if there was an audio error." Other participants were more complacent about connectivity issues, with Kate stating, "There was one spot where the video did hang, but I would say it did not diminish [the experience]. It's a part of being in the technology world. We experience that with our smartphones and what not all the time."

Viewing Experience. Some participants found it difficult to view the content on the tablet in bright sunlight. Most stops on the tour were located in areas without shade and as Kate noted, "Due to the bright sunshine, sometimes it was difficult seeing the screen on the iPad." This did result in some impact to the user experience as users found it difficult to view the content in some cases. Luke reported, "Some of the current photos were dark and hard to see while being in the sun during the walking tour."

Difficulty seeing the content due to sunlight caused some participants to adjust their experience to cope with the challenge of the bright sunlight. Betty addressed the problem "ducking under trees to try and make sure that I could see things." and suggested that the contrast for the photos be modified to alleviate this issue, "a few dark interiors could have used some lightening up to help see the details in a high contrast outdoor viewing."

Dramatization. A feature of the tour that participants particularly appreciated was the dramatization within the audio tour. Quotes from historical figures were included within the audio tour in a different voice from the narrator to stimulate interest. The original design of the tour had only one voice as the narration for all of the audio commentary. However, this was changed based on a comment from one of the super users, Coral, in her interview. Coral stated, " I really enjoyed the parts where it was more like a story or hearing the quotes from the former founders of the complex." Coral went on to suggest, "I think that having a male voice for the portion that were quotes I think would add more of a storyline or a play." Based on this suggestion, for the Phase 2 participants, the portion of the audio commentary that included quotes from former Deans and Administrators was changed to a male voice in contrast to the female voice used for the rest of the audio. Participants responded positively to this feature, with Tina noting, "I loved the voice... His voice-overs within the audio" and, "It makes you sort of feel like you're now taking me really back in time."

Stimulation and Interaction. The tour was designed to enhance user experience at the site without creating cognitive overload. As such, the audio commentary was designed to be experienced while the user was engaged in the physical site. Historical and current photos were to be viewed independently of the audio tour to encourage visitor engagement with the physical site.

When participants were asked in the survey to identify the most enjoyable features and least enjoyable features of the tour, taking into account the following features: historical photos, current photos, video, Step Into The Past, and the audio tour, participants overwhelmingly rated the audio commentary as their favorite part of the tour.

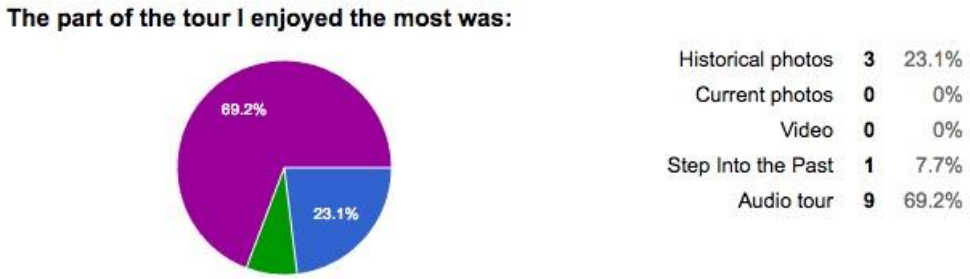


Figure 21. COE Tour V1.0 Most Enjoyable Feature

69.2% of participants found the audio tour to be the most enjoyable aspect of the tour, while 23.1% found the historical photos to be the most enjoyable and 7.7% enjoyed the Step Into the Past activity to be the most enjoyable. None of the participants rated the current photos or the video as their most enjoyable feature.

Although users found the audio tour to be the most enjoyable feature, they did state that they wanted additional information and interaction with the visual content in the tour while listening to the audio commentary. As Betty stated, "I wanted to hear the history; it just would have been nice to have a little visual entertainment while I was listening." Kate similarly requested the ability to view the photos while listening to the commentary, saying "I would have liked to see the pictures match up with the audio portion instead of seeing them after the narrative has ended." Other participants noted that having the photos in conjunction with the audio commentary would have been more impactful and would have helped with cognitive processing. Alex reported, "I feel like if I had some visuals to go along with it... that would've helped to more solidify that in my short-term memory." Kate agreed, saying," so you're talking about the towers. I could see a picture of it and it would probably hold my interest a little better."

Some participants noted that additional stimulation through the visual content would have retained their interest in the tour better. Kate stated, "In some spots I was zoning out a little, but I don't know if it was because there was just that one photo and whatnot." Participants also voiced a desire to be able to multitask and not be limited to just listening to the audio. Tina reported, "At some point I was just sort of like, well, I'm standing here. It would be really nice if I could multitask." She expressed the desire to multitask by stating, "I think I've been now indoctrinated into a generation of where I need to be doing two or three things at once."

On-Site Experience. Participants overwhelmingly felt that the tour would not have the same impact if the tour was not used at the site. They cited that actually seeing the buildings while listening to the commentary was an immersive experience. Participants noted that it was an enjoyable experience to be in the actual location and that it stimulated interest. Gail noted "When you mentioned something interesting, I went to go look at it. I walked to it and I went to see the real thing."

Kate stated that she had an emotional reaction to being on site while listening to the tour and that it resulted in more of an impact, “Being there and looking at the site, the building that had burned, it brought a little more emotion. I think just looking at it on a screen away wouldn't have had that kind of impact.” Similarly, Tina agreed that the impact was greater viewing the tour on site, saying, “I think I wouldn't get as strong a sense of like, wow, these buildings need some help.”

Penny noted that being on site provided the opportunity for more perspective that she felt she would not experience in another location, “I really liked being able to look at the actual buildings, and be in the actual location, rather than, for example, being inside of a museum, looking at a display with pictures. I think it gives you more perspective.” Other participants appreciated the immersive experience of participating in the tour at the site. Coral noted. “I was immersed in the experience of the tour. I think because I was physically there looking at it while I was listening to what was in the past and current and the future, the last part of the tour.”

Some participants noted the pure enjoyment of being on site. Penny reported, “there's just something very human, I think, about intrinsically wondrous, of looking at something, and hearing about how, and seeing how it used to be, and doing that comparison.” She also noted, “It was surprisingly pleasant to be able to take a tour while outdoors, unaccompanied by a group, and look at the location being talked about.” Fred also expressed his enjoyment, saying, “you're at the area and just hearing about it while you experience what's around you, that's really enjoyable.” 92.3% of participants agreed or strongly agreed that they enjoyed the tour, with none of participants disagreeing or strongly disagreeing that they enjoyed the tour.

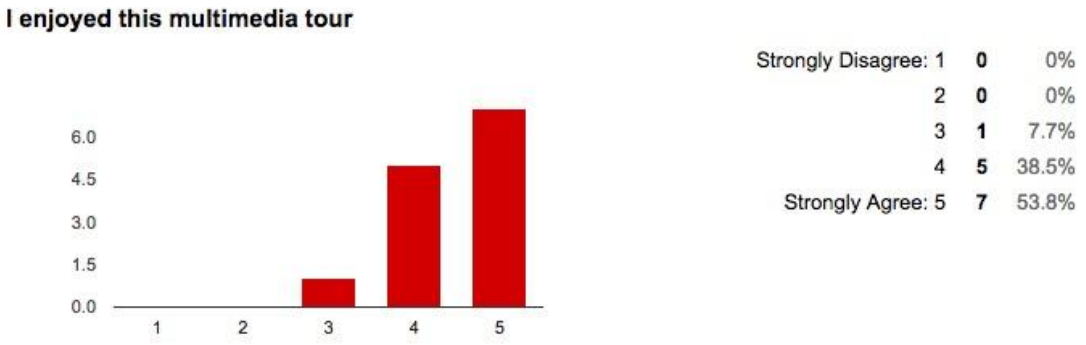


Figure 22. COE Tour V1.0 Tour Enjoyment

Shane, a current COE faculty/staff member was the only participant that did not agree or strongly agree that he enjoyed the tour. However, Shane did comment that tour would be valuable for COE faculty/staff and students, noting, "The history of the COE was interesting. I think for those working or studying in the COE the history would be significant." Moving beyond just personal enjoyment of the tour, 100% of participants agreed or strongly agreed that they would recommend the tour to others.

Content Value. Participants found the tour content and the audio tour to be valuable, powerful and enjoyable. Participants were asked about their impression of the tour content and how interesting it was to them. 92.3% of participants found the content to be of interest, with none of participants strongly disagreeing or disagreeing that the content was interesting.

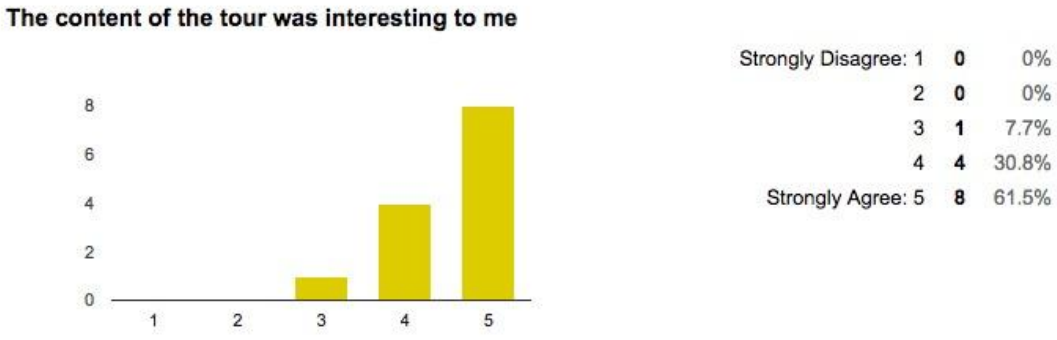


Figure 23. COE Tour V1.0 Tour Interest

Similar to the question about tour enjoyment, Shane was the one participant that did not agree or strongly agree that the tour was interesting to him.

Alex stated, “I enjoyed the audio portions. They were well narrated, good pacing, a lot of information I never would've learned otherwise.” Betty noted, “I really enjoyed the depth of background on the voice tour.” Others found that they learned new information through the historical content even though they had prior associations with the campus or the College. Kate reported, “ I really did enjoy it and sincere in saying that - I've been on this campus, on the Keller side for 24 years and there's a lot that I don't know. “ Gail, a current College of Education staff member and one of the super users, voiced her surprise at learning about the COE by stating, “It's really sad that I worked here for three years in the 90s when the elementary school building still existed, but I have no recollection of it. I didn't even realize that UHS 2 had a basement on one end. I learned so much about the buildings and the people whose names they bear.” Tina summed up her response to the tour content by saying, “I think it's powerful.” Participants were asked if the tour increased their knowledge of the College of Education’s history.

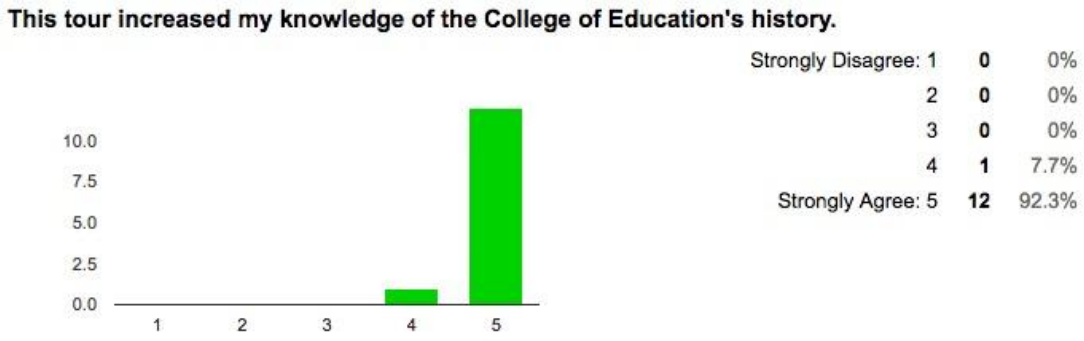


Figure 24. COE Tour V1.0 Increase of Knowledge

100% agreed or strongly agreed that the tour increased their appreciation of the College of Education.

Appreciation of Site. After completing the tour participants expressed a deeper appreciation of the College of Education and its history. 100% of participants agreed or strongly agreed that the tour increased their appreciation of the College of Education’s history.

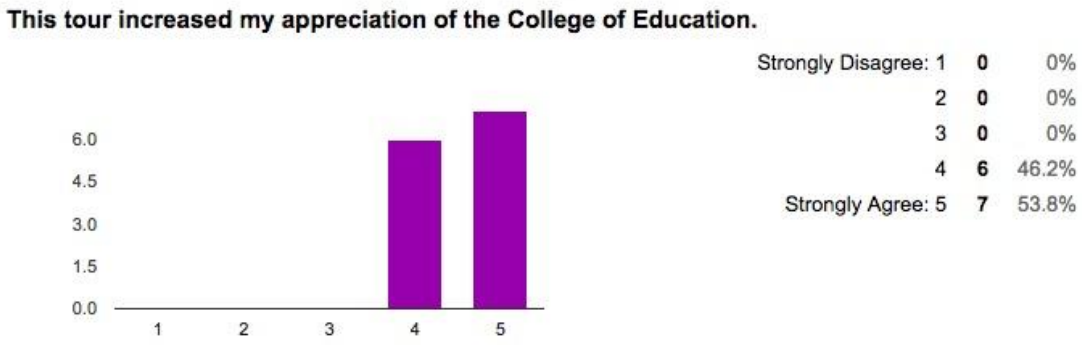


Figure 25. COE Tour V1.0 Increase in Appreciation

Kate, a participant without a direct connection to the College of Education, explained her increased appreciation of the site by stating,

> Parts of the campus as you walk by or drive by, they look a little run down. In your head you may be thinking, "What's there, it just needs improvement," that kind of thing. Hearing about how old the buildings were, what the history was, how it was used during the war, that sort of thing did give me a better appreciation of historical value.

Kate also reported, “After the tour, I have a much better appreciation for what the COE provides for educators and students.” Current staff and faculty that participated in the tour also claimed to have a greater appreciation for the College with Tina stating, “I learned a lot about the rich history of the college and it's vital work for the state.” Luke noted, “I now have a greater appreciation for the place I work and can identify better with colleagues who share with me history of the COE.” This appreciation for Coral, a super user, current COE faculty/staff member and current COE student, translated into a concrete feeling of connection and action.

> *I feel more vested, actually. If we were more supportive of what I could do individually and as a whole what I could contribute to making sure that the college doesn't further get neglected.*

Summary

Response to COE Tour V1.0 was generally positive. The interface design was found to be simple and easy to use. Participants enjoyed the outdoor tour experience, although they did cite some issues with the physical experience such as difficulty seeing content in high sun, wifi connectivity, and wayfinding. Participants also noted a desire for greater control over the audio commentary and viewing the visual materials.

CHAPTER 5. COE TOUR V2.0 REDESIGN AND RETEST

After the testing of COE Tour 1.0 was complete, the survey data and the interview transcripts were examined to identify design elements that impacted ease of use and user enjoyment. Overall, most users enjoyed the tour and found it a valuable tool to learn more about the COE. However, it was clear that the design concept of creating the tour as an augmented audio tour was fundamentally flawed. Users wanted greater control over access to the content and how it was presented. They wanted and expected more than an augmented audio tour.

To satisfy this desire and to address other problems identified by participants the following design concepts were revised: audio player, supplemental visual access, icons, access to the Step Into the Past feature, and the tour map. This chapter discusses these revisions to the tour and participant response to the revised tour, COE Tour V2.0.

Redesign: Responding to User Feedback

Retaining the Positive

For the redesign of the tour, features that participants valued and rated highly were retained. Since participants responded well to the simple design of the pages and interface, this concept was retained for the redesign. Due to the very positive response to the audio tour, its content and the dramatization, this feature was retained, with no changes in content. Participants also felt that the amount of content, both the audio content and the supplemental visual materials was appropriate and not lacking, so the amount of information in the tour was kept the same. No new information was added and none removed.

Since participants also highly valued and enjoyed the Step Into the Past feature, this was retained, although some changes were made to how the feature was accessed, as discussed in the following section. The historical photos and current photos were also kept in terms of presentation, the slideshow, and the amount of photos.

Changes and Enhancements

Analysis of the findings from the COE Tour V1.0 testing revealed certain areas of the design that could be changed to enhance the user experience. The areas included media control,

control over content, icons, tour map and orientation, and sequence choice. Revisions to the tour design were implemented to make the design more compatible with participant expectations and desires.

Media Control. Overwhelmingly, participants cited the desire for greater control over the audio commentary and the supplemental visual materials. Participants wanted to be able to fast forward, rewind, and restart the audio tour. In the original design concept, it was thought that the short length of the audio commentary meant that visitors would not need these controls. That appeared not to be the case and that visitors desired and expected that they would be able to have fine control over the audio player. To address the issue of audio control, the audio player interface was changed to include a progress bar with the ability to 'scrub' through the audio track to rewind or fast forward.

Control Over Content. Participants also cited a strong desire to have greater control of how they viewed the supplemental visual materials. COE Tour V1.0 was designed to replicate the audio tour experience by having visitors listening to the audio while viewing the site, leaving the supplemental visual materials to be viewed after the fact. This design to limit visual channel input was in line with Mayer's (2009) Cognitive Theory of Multimedia Learning. However, as noted in chapter 4, participants actually wanted greater visual stimulation and voiced their desire to be able to multitask, viewing the supplemental materials at the same time as they were listening to the audio commentary. Many participants reported that viewing the buildings while listening to the audio commentary was not sufficiently stimulating.

To address this critical issue, the stop page design was significantly revised. The most dramatic change was to incorporate all of the supplemental materials into the initial stop page. The Peek Inside and Look Back images were combined into a single slideshow available on the stop page. A single image appears in the center of the page, and on the right side there are thumbnails that can be scrolled through for viewing. Selecting a specific image from the thumbnails in the slideshow enlarges that image and its caption. With this new design visitors can scroll through the images at their leisure as the audio commentary progresses, providing the freedom to view images of interest in large scale.

The redesign allows the user greater control over viewing the visual materials and listening to the audio. The visual materials lose their categorization into current and historical photos, but the use of the scrolling thumbnails provides the ability to quickly view the thumbnails to select an image of interest.

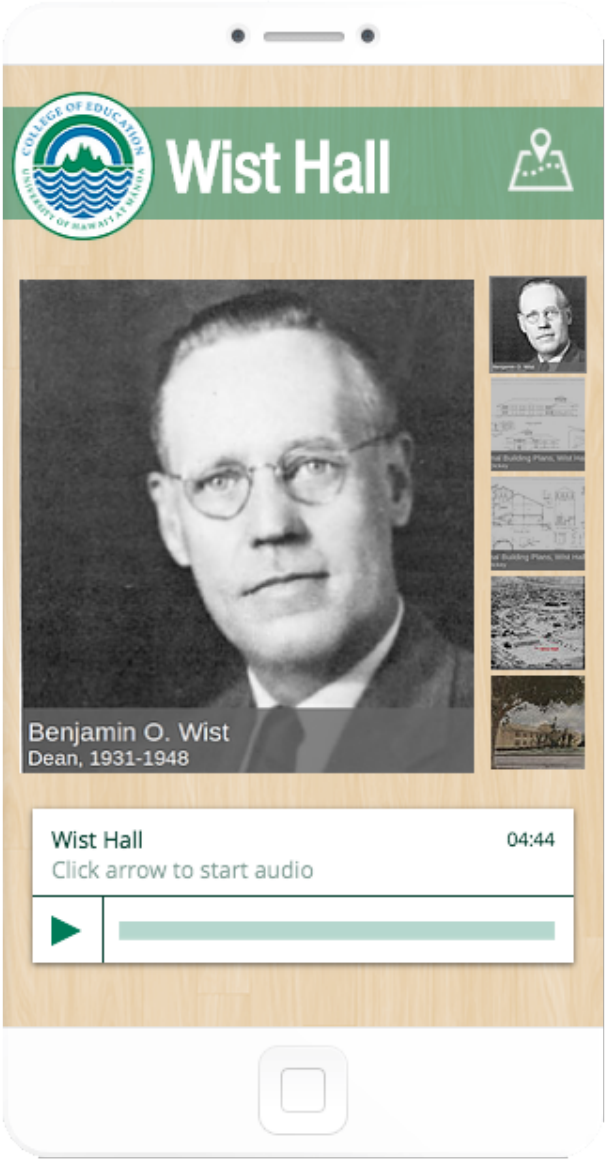


Figure 26. COE Tour V2.0 Stop Page for Wist Hall

Icons. Significant effort was put into choosing relevant icons for the three categories of supplemental visual materials for COE Tour V1.0, Peek Inside, Look Back and Step Into the Past. However, even with an introductory description of the icons at the start of the tour and

reinforcement within the audio commentary, many participants indicated that they had trouble remembering what each icon was for. The icons were clearly confusing and using participant cognitive load as users tried to remember what the icons represented. As part of the redesign to make the supplemental images available while listening to the audio commentary, the row of icons on the bottom of the page was removed. By removing the icons, a source of user confusion and potential increase in cognitive load was eliminated.

Although the icons for Peek Inside and Step Back were no longer needed, the map icon was still required to allow users to return to the main navigation page. To this end, the map icon was retained and moved into the header bar to allow users to navigate back to the map.

The changes to the stop pages led to the question of what to do with the Step Into the Past feature. The elimination of the icons on the stop page and the three categories of supplemental visual materials removed the ability to access this feature from the stop page. To address this issue, the Step Into the Past locations were separated from the individual stops and noted on the map page for visitors to view.

Tour Map and Orientation. The footsteps icon for Step Into the Past was retained and used as a marker on the COE Tour V2.0 map. Making the Step Into the Past feature separate from the tour stops has two additional benefits. Users now have greater control over content. If desired they can view the Step Into the Past independently or even in place of the stops. Since the Step Into the Past stops have their own audio commentary they have no required interaction with any stop page and can be viewed as a standalone feature.

Other revisions were made to the map page based on participant responses. Some participants noted that they had difficulty with wayfinding and locating the various stops on the tour. The separation of the Step Into the Past and stop pages allowed Tour Stop 1 to be shifted to the opposite side of Wist Hall. The not only condensed the tour area to make it easier for visitors to find the location of the stops, reducing confusion in wayfinding, but also provided access to a stronger WiFi signal. The signal was particularly weak in the previous stop location, but was considerably stronger in the new location for Stop 1.

Figure 27. COE Tour V2.0 Map

Sequence Choice. Some participants noted that they wanted to view stops in a different order than the chronological order presented. COE Tour V1.0 does allow this ability since the map has all stops and any stop can be accessed form the map at any time. However, access to the final pages of the tour, the links to the reference page, the COE Stories submission page and the question submission page were only able to be accessed from the End arrow located on Stop

Page 6. To enhance the ability of participants to control stop sequence, an 'End the Tour' arrow was added to the map. This allows users to conclude the tour at any time, providing them with greater control of the progress of the tour. Users no longer have to progress through stop 6 to access the final pages of the tour.

The revisions made to the COE Tour V1.0 were expected to provide a tour experience more in line with user preferences based on the data from the surveys and interviews. COE Tour V1.0 was designed to be an augmented audio tour, but data from participants led to revisions that morphed COE Tour V2.0 into a different design concept. The revised tour became more of an information portal that provides users with greater control over access to content and device interaction.

Limitations and Continuing issues

Although the redesign addressed the most critical design issues identified by participants, there were some issues that were not addressed in the redesign.

Content Choice. Some participants noted that they would have liked to have greater control over selection of topics for the tour. Many participants cited disinterest in the discussion of architectural features in particular. Others felt that they would have liked to be presented with different options and subjects to explore, allowing a deep dive into those of particular interest. Since the COE Tour was intended to be an overview tour, covering a range of topics, and since participant response to the audio commentary was very positive this design of content presentation was not explored for the redesign.

Tour Map and Orientation. Wayfinding and orientation were also cited as an issue for participants testing COE Tour V1.0. Although users were able to find the stops, some did cite problems finding the stop locations form the map and orientating themselves on the COE campus. GPS navigation would be a possible solution. This option was not explored for the redesign since it is not currently an option available with Wix. GPS navigation may be available in other DIY software, but it is unclear if the technology is currently able to provide fine-grained location identification with high accuracy.

Viewing Experience. A few participants noted the difficulty viewing certain images in bright sunlight. Some of the darker images could have been lightened for COE Tour V2.0 to help

ameliorate this situation, but since COE Tour V2.0 was not going to be tested on site with participants, this revision was not implemented.

COE Tour Version 2.0 User Testing Results

After development of COE Tour V2.0 was complete a survey was conducted with the eight interview participants. The survey included screenshots of the COE Tour V2.0 design as well as links to access the live tour. The survey asked questions to clarify participant opinions on aspects of COE Tour V1.0 and to collect their responses to the sample of COE Tour V2.0. All eight of the interview participants completed the survey for a 100% response rate.

Control Over Content

In response to follow up questions about the original tour, 62.5% of respondents agreed or strongly agreed that they wanted more control over the content they viewed in COE Tour 1.0.

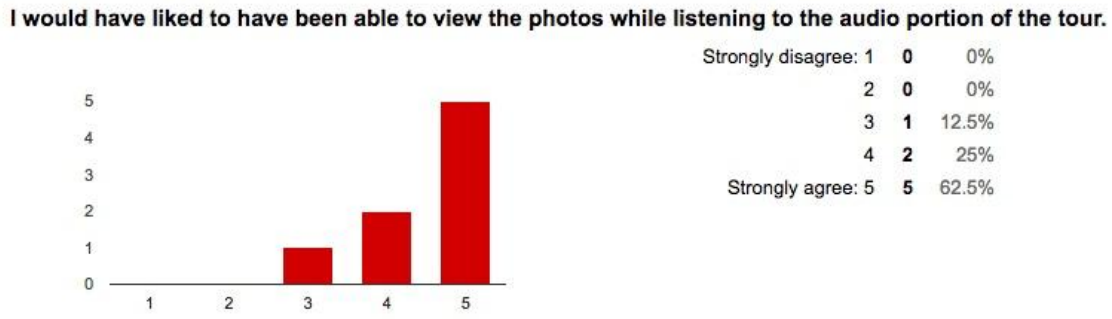


Figure 28. COE Tour V2.0 Desire to View Photos While Listening to Audio

87.5% strongly agreed or agreed that they would have like to have been able to view the photos while listening to the audio portion of the tour, allowing greater control over content.

Participant answers to the open ended questions in the COE Tour 2.0 survey confirmed that they liked the ability to have greater control over the audio and the visual materials and appreciated the revisions to the tour in this regard. Kate reported, “I like being able to click to the different photos at my own pace. I can click ahead as well as go back quite easily.” Gail, one of the super users, concurred, stating, “I also appreciate being able to flip through the pictures on my own.” Coral, another super user, reported that she preferred the revised tour as it gave “The ability to scroll through the beautiful pics and scrub through the audio.”

Participants also expressed their appreciation for the progress bar to provide feedback on status. Gail reported, “I like knowing how long the audio is and how much more there is to listen to. It is also helpful to be able to fast forward or rewind the audio as needed.” Betty stated, “I love the progress bar. Since it takes a while to get from place to place and I like to move around to look at things in context have a pause or jump back option is nice.”

Stimulation and Interaction. Other participants noted that being able to view the visual materials at the same time as they were listening to the audio tour enhanced their enjoyment of the tour and the tour impact. Betty stated, “Because I can look at images while the audio is playing. I can hear, look at the building and look at the historical references simultaneously. This really helps me to understand the context more fully.” Penny commented, “I was happy just looking at the buildings in the first version, but do feel that additional pictures enhanced the experience. More ‘food for thought’." None of the participants reported feeling overwhelmed by viewing the visual materials as they were experiencing the physical site and listening to the audio commentary.

Some participants did note that they would have liked a closer tie between the visuals and the audio commentary. Fred, one of the super users, noted, “I would like the pictures to sync with the audio.” Others agreed, feeling that a closer correlation of the audio and photos would provide greater impact and understanding, Gail stated, “I think I would get more out of the tour if the pictures were in order and correlated to the audio.” Similarly, Tina noted, “I like the additional pictures that go with the audio but would like if the pictures were presented in the timeline order in which they are talked about.”

Evaluation of Original Tour versus Revised Tour

When presented with a sample of the revised tour, 100% of respondents stated that they preferred the revised version of the tour. 100% felt that they could best access information in the way they prefer using the revised tour.

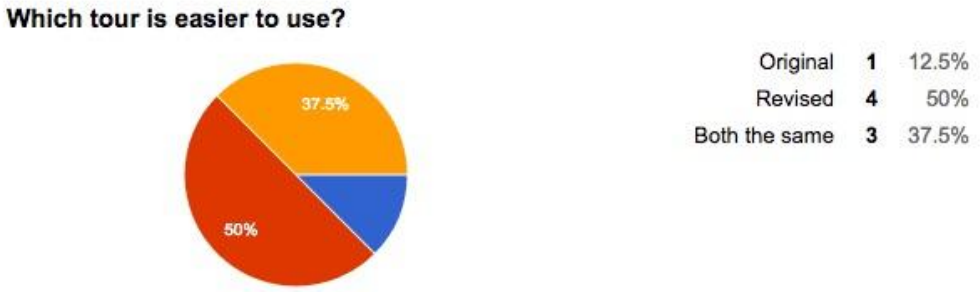


Figure 29. Ease of Use COE Tour V1.0 versus V2.0

50% of respondents reported that they felt that the revised tour was easier to use, and 37.5% felt that both tours were the same in terms of ease of use.

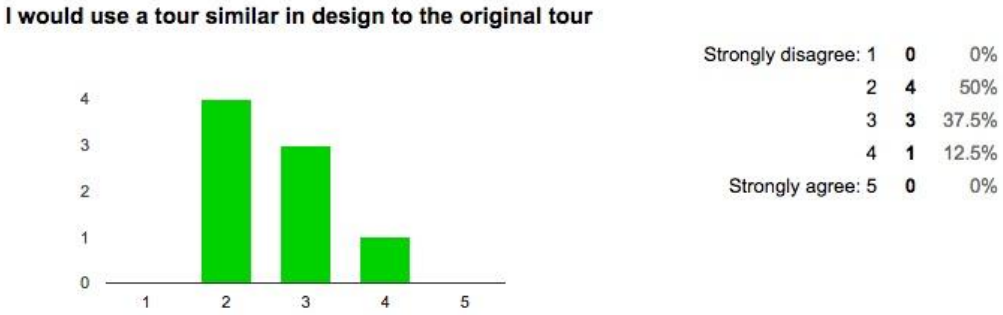


Figure 30. COE Tour V1.0 Intent to Use

12.5% of respondents agreed or strongly agreed that they would use a tour similar in design to the original tour. 100% of respondents agreed or strongly agreed that they would use a tour similar in design to the revised tour. In addition, 100% of respondents reported that they would recommend COE Tour V2.0 to others.

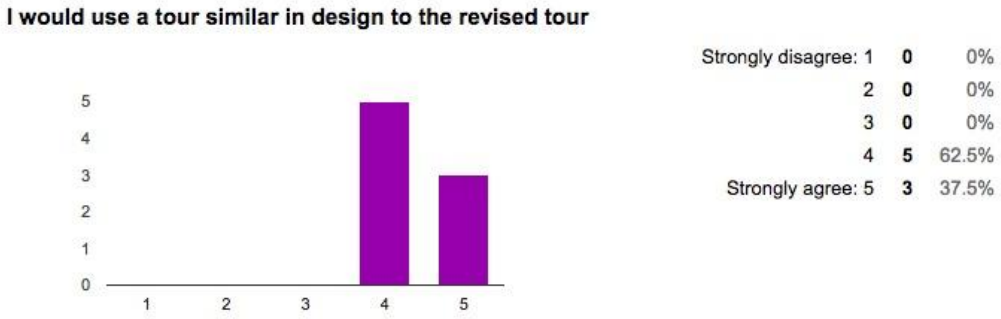


Figure 31. COE Tour V2.0 Intent to Use

Summary

Findings from testing of COE Tour V1.0 found that participants desired greater control over the audio commentary and viewing the visual materials. Instead of an augmented audio tour, participants wanted a tour that would allow them to explore and control content as they wished. The tour was revised to provide this greater control and access to users. Revisions made to the tour to address these critical issues for user ease of use and enjoyment were received positively. After viewing the revised tour, participants found the revisions made the tour easier to use and provided the control they desired for a better tour experience. Some design elements that were considered problematic were not changes due to limitations: map navigation, options for topic selection and image quality. A compete list of design elements and status is shown in Table 5.

Participants stated that they valued the revised tour, COE Tour V2.0, and found it just as easy if not easier to use than COE Tour V1.0. All eight participants responded that they would recommend COE Tour V2.0 to others.

Table 5. List of Design Elements and Status

Design Elements Retained	Changes made – satisfactory	Changes made – continuing issues	No changes - limitations
Audio content	Elimination of icons	Images linked to audio commentary	Tour navigation
Amount of content	Visuals incorporated on stop pages	Connectivity	Topic Selection
Step Into the Past	Map modifications to enhance sequence choice		Image quality
Dramatization	Audio player controls		
Simplicity of interface	Step Into the Past feature added to Map		
Slideshow for supplemental images	Location change for Stop 1		

CHAPTER 6. DISCUSSION AND CONCLUSIONS

Technology adoption is challenging in any environment. Convincing users to embrace a new technology or technology design is complicated by the huge disparity in individual needs and preferences. In work environments, adoption of newly introduced technologies can be enforced by policies and procedures, but in leisure environments there is no such driver for adoption. Visitors have choice and only adopt new technologies voluntarily. New technologies presented for visitor use must have wide appeal and useful functionality for them to be adopted. As presented in Chapter 1, this design case study explores the area of design of multimedia mobile tours in leisure environments to determine the features that lead to greatest enjoyment/value and ease of use to enhance adoption by visitors. Using the TAM as a model, the research questions discussed in chapter 1 focus on the design features that can affect ease of use and value to ultimately enhance adoption. The design of the tour was based in the literature presented in Chapter 2 to build on current design research to enhance value and ease of use for mobile multimedia tours. The tour was also designed using DIY Website software to demonstrate that an engaging and useful tour can be created at low-cost without the need for programming knowledge.

Major Findings

This study found two variables that led an increase in visitors' perceived usefulness/value of the tour. These two variables were control and stimulation. Two variables that affected visitor perception of ease of use were also identified. These variables were simplicity and reliability.

Control

In studying variables that lead to perceived usefulness or value in design for technology adoption, the biggest driver for participants was the ability to have control over their own learning. A. Lin, Fernandez, and Gregor (2012) found that control over learning is a key factor for learning and enjoyment. Gammon and Burch (2008) similarly found that users must have the ability to control information of interest to them and to be aware of tour flexibility. This was

supported by this study, as one of the major issues for participants was the ability to have control over the presentation of content, content choice and sequence.

In this study, participants wanted to be able to choose the topics for the content. They wanted the option to pick and choose what to explore and to have the choice to do a deep dive into a particular topic of interest. They also wanted to be able to control the flow of content, to skip forward in audio, or scroll through images, in order to access the content of interest to them, and bypass those areas of less interest. Finally, participants wanted to have the freedom to explore the site as they desired, not in a pre-planned path.

Gammon and Burch (2008) found that designing generic or 'one-size-fits-all' tours does not sufficiently cater to individual visitor wants and needs. Filippini-Fantoni and Bowen (2008) concur, suggesting that institutions create a variety of specific tours targeting individual interests. The COE Tour V2.0 addresses this desire for custom tours by providing visitors with control to personalize the tour and access content of particular interest to them. Providing visitors with flexibility and control led to greater satisfaction with the tour.

Stimulation

Another variable that enhanced perceived usefulness and value for the tour was stimulation. Traditional audio tours in leisure institutions provide information through the audio channel while the visual channel is absorbed in viewing the site or object. This falls in line with Mayer's Cognitive Theory of Multimedia Learning (Mayer, 2009) which seeks to limit audio and visual input to reduce extraneous processing and keep audio and visual channels from being overloaded. However, participants in the study showed that they craved additional stimulation and wanted the ability to multitask and view the site and images on the tablet as they listened to the audio tour. The participants felt that there was greater impact and interest if they had the ability to increase stimulation of the visual channel with both tablet-based content as well as the site content. These finding run counter to Mayer's Cognitive Theory of Multimedia Learning in this regard.

Increasing stimulation and providing a multisensory experience also can lead to more engaged and mindful visitors as described by Moscardo (1996). Mindful visitors are more active, curious and interested in the site and as a result develop greater appreciation of the site and even the site's overreaching organization. Additional stimulation can also satisfy the desire for a more

immersive environment and richer experience as noted by Carson (2008). Falk & Dierking (1992) also suggest that a multisensory experience can help visitors personalize their experience, and A. Lin et al (2012) found that a multisensory experience one of the primary factors in designing an enjoyable museum learning experience.

Simplicity

The COE Tour was designed to appeal to a wide range of users with a wide range of technical expertise. Following Cooper (1999) and Colborne's (2011) recommendations, the tour was designed to appeal to the mainstream user, not expert users. As both Cooper (1999) and Colborne (2011) identified, this mainstream user may become frustrated by complexity in design. Therefore, simplicity was a guiding principle of the design, and participants in the study did appreciate the simplicity of design for the tour. The tour incorporated Colborne's (2011) recommendations for simplicity in design, by maintaining sensible groupings, eliminating non-essential features and providing clear navigation. Therefore, the design of the tour was kept clean and easy to understand in terms of functionality. This is consistent with Nielsen's (2013) claims that interfaces should be designed with only essential features and making these features obvious and with clear functionality.

Elimination of the icons and the consolidation of images also reduced extraneous cognitive load as described by Sweller's Cognitive Load Theory of Multimedia Learning (1994). Icons that appeared in COE Tour V1.0 required visitors to learn associations of the icons with the feature they represented. Removing these icons and inserting the supplemental visual materials into the stop page lead to a reduction in extraneous cognitive load as visitors no longer had to make the association between the icon and its function.

Simplicity of design was inherent in the initial interface design for COE Tour V1.0 and the design was enhanced by elimination of icons and consolidation of features in the revised tour, COE Tour V2.0. Participants responded well to the revised design and found it easy to use.

Reliability

Reliability was a critical variable for tour ease of use. The spotty WiFi connection during the Phase 1 testing was a significant problem for participants and it detracted from their tour experience as they became frustrated with the connectivity and were required to work around network lag and disconnection. In this case users were more focused on the device and its

malfunction than with the tour itself. Reynolds, Walker & Speight (2010) noted that device malfunction can significantly affect user enjoyment, and this was supported by the findings in this study regarding the WiFi connection. Further supporting the idea of reliability as a critical variable for user experience, Anderson's model of User Experience Hierarchy of Needs (2011) identifies reliability as a critical factor for increasing user engagement. Anderson describes reliability as a technology that is "always available and accurate." (2011). A tour that is free from malfunction and is consistently reliable will be easier for visitors to use and will lead to a better tour experience.

Tour Design and the Technology Acceptance Model

The Technology Acceptance Model (TAM) was the conceptual framework used by this study to explore user adoption of technology. As discussed in Chapter 1 and Chapter 2, the TAM has been widely used to explore technology acceptance in work environments, but rarely used in other environments including informal learning environments.

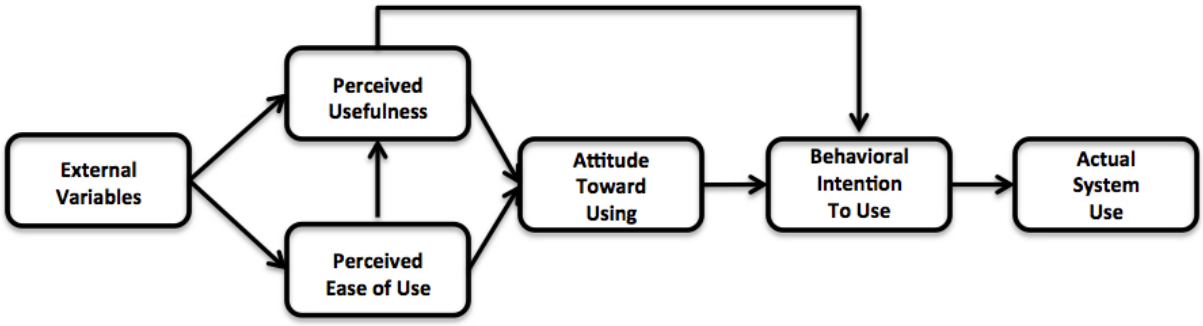


Figure 32. Technology Acceptance Model (Davis, 1989)

This study uses the TAM to apply technology acceptance in leisure environments. These environments are less structured than work environments and users have greater choice over technology adoption. This study shows that the TAM is applicable to other environments such as leisure organizations, and confirms the model's accuracy for determining technology acceptance and adoption.

This study has identified two variables, control and stimulation, for multimedia mobile tour design that can impact perceived usefulness/value in the model. Participants cited their desire for greater control over the content and how it was presented as issue for satisfaction with

the tour design. In the revised tour, COE Tour V2.0, control over the content and how it was presented, particularly with additional control for the audio player, and easier access to images, led to greater satisfaction with the tour. Opportunity for additional visual stimulation, by allowing images to be viewed in conjunction with the audio tour also increased participant satisfaction and intention to use the tour. The two changes led participants to value to COE Tour V2.0 more than the original tour, COE Tour V1.0, which did not have these features for control and stimulation. Therefore, control and stimulation are identified as external variables that can impact perceived usefulness in the Technology Acceptance Model as it applies to mobile multimedia tours.

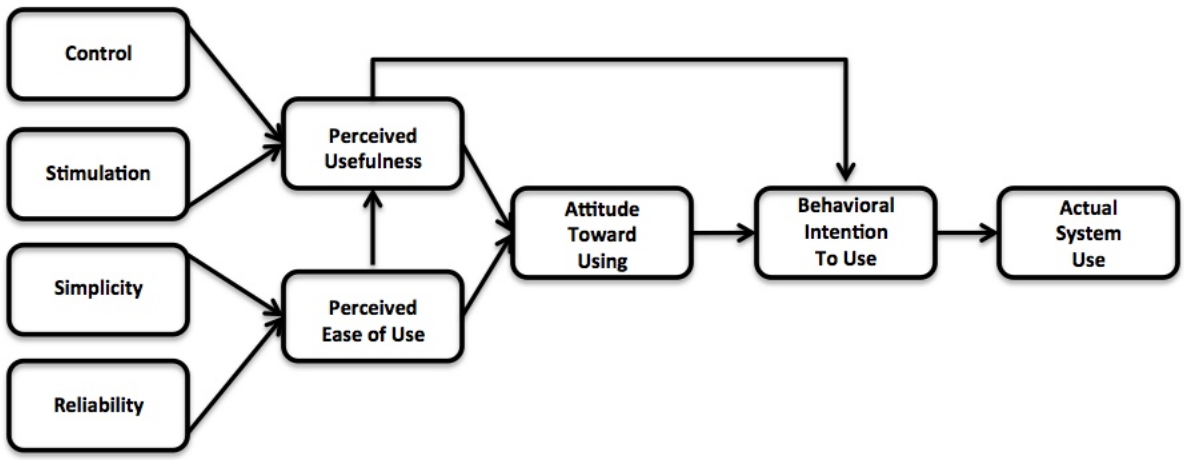


Figure 33. Technology Acceptance Model for Mobile Multimedia Tours

Two variables, simplicity and reliability, were identified as external variables that impacted participant perceived ease of use. Simplicity in design was a primary goal of the tour from the initial design concepts. Non-essential features were eliminated and items were organized into sensible groupings. Simplicity of design was enhanced in COE Tour V2.0 by eliminating icons and combining elements to limit the number of features. Addressing the problems with the WiFi connection after the initial test by super users enhanced reliability of the tour. The more reliable connection provided through the mobile hot spot led to few issues with connectivity noted by participants. Simplicity and reliability, as used in the study, led to high participant satisfaction with ease of use of the tour. Therefore, simplicity and reliability are

external variables that have been added to the Technology Acceptance Model for multimedia tours which impact perceived ease of use.

The four new variables that impact both perceived usefulness and perceived use of the tour should then impact attitude toward using, resulting in behavioral intention to use and finally actual system use. This new model of the Technology Acceptance Model provides greater clarity on the external variables than can lead to actual system use for mobile multimedia tours.

Tour Development and Methodology

The process for development and testing as implemented for this project should be considered as a model for future research in user experience. Similar to the ADDIE model, the methodology for this project provides guidelines for development and testing as a generic process that could be used by others engaging in similar development research.

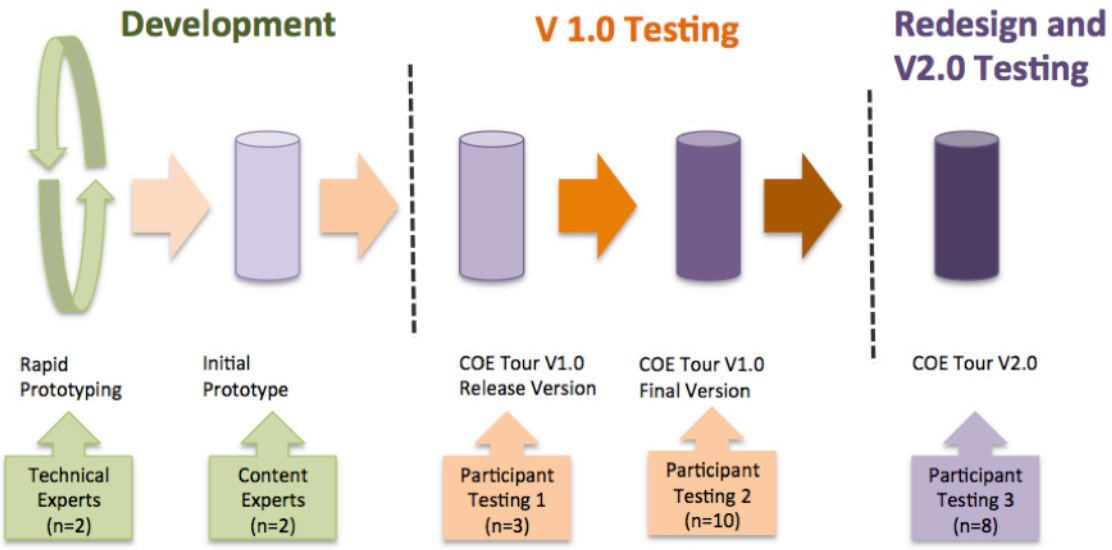


Figure 34. Development and Testing Process

This model could be further modified to include a pre-development phase to address the need for systematic analysis and selection of software to be used in the development phase. In addition, inclusion of a formal evaluation of the initial prototype during the development phase could preemptively identify issues related to the initial prototype that would be revealed during the testing phase. Finally, the final phase of the process should include a formal re-test of the

final version, duplicating the testing process in the first phase of testing. This re-test would result in a more comprehensive collection of data related to the redesign.

Implications for Practice

The study has shown that it is possible to create an impactful multimedia tour experience at low-cost for leisure institutions. Based on the TAM model and the findings from the study, the design principles when applied to a multimedia tour, can lead to adoption of this technology by visitors.

Based on this study, to enhance adoption of mobile multimedia tours design should provide visitors with the ability to have fine control over their access to content, the type of content they want to access and the way they access the content. Tours should also provide sufficient stimulation and the opportunity for users to consume multiple types of information through their visual channel.

To enhance ease of use, design for mobile multimedia tours should embrace simplicity, eliminating non-essential items and keeping items grouped into sensible groupings. Navigation and interface should be simple and uncluttered. The device should be reliable and free from distraction caused by malfunction. If network connectivity is required, then this connectivity must be fast, consistent and reliable.

Finally, the study shows that a valuable and engaging tour can be created with little technical expertise. Filippini-Fantoni and Bowen (2008) found that development costs for multimedia tours are significantly higher than audio tours, particularly when taking into account the cost of providing comsumer-grade hardware. This study demonstrates that by using free or low-cost DIY Website software, an institution can create a mobile multimedia tour that is well received by visitors by following design guidelines for control, stimulation, simplicity and reliability. High programming costs, significant programming skills, and expensive services are not required to provide visitors with a valuable tool for learning and engagement. In addition, by developing the tour as a Website, visitors can use their own devices and the institution is not required to expend funds on hardware and hardware upkeep. However, using DIY software does have limitations for design and is not as flexible as development of custom software. Using DIY software may result in some design compromises and may require some creativity to manipulate the software's provided features to create the design desired.

Limitations

This study had a number of limitations that should be considered when evaluating the conclusions. This study had a small sample size, which although appropriate for a design case study, does affect wider application. Further study should be done with a greater sample size to more fully evaluate the findings.

In addition, a high number of participants had some association with the COE, either as faculty/staff, students or relatives of a COE faculty/staff or student. As a result these participants would have a greater connection to the COE and be more interested in the tour subject. This may be mirrored in museums and other leisure organizations where visitors voluntarily visit because they have already identified an interest in the area on exhibit, but research into the applicability of the findings to populations without a fundamental interest in the topic should be explored.

Finally, participants were interacting during the project testing with the researcher as designer. Knowing that the researcher was the one evaluating the data from surveys and interviews may have inspired bias and led participants to limit their criticism of the design. Future research should be done with an independent researcher to reduce any bias.

Recommendations for Future Research

This study was limited to the tour experience for outdoor tour sites. It would be valuable to apply these design findings to other venues, including indoor exhibits. Participants highly valued being on-site and using the tour to explore an outdoor venue. However, it would be worthwhile to determine if these findings can be universally applied to all exhibit spaces, indoor and outdoor. Indoor exhibits have different limitations and considerations for tour deployment. Applying the design principles found in this study to other exhibit environments would confirm their universal application.

It would also be valuable to apply the design principles from this study using other software to determine that other platforms can produce the same results. If other platforms and software can be successful at creating the same design experience it would provide more options for leisure organizations seeking to create such tours. Having flexibility for development would increase the ability of organizations to easily and inexpensively create valuable and successful multimedia tours for their visitors.

An additional area for exploration should be navigation technology. Availability, accuracy and affordability of GPS technology are increasing. This technology may be able to significantly increase ease of use for site navigation. Future study in this area should explore this technology in mobile tour use and its impact on ease of use for visitor navigation.

Finally, design to support Universal Design for Learning (UDL) should be explored for mobile multimedia tours. The challenge to provide UDL options in this environment was beyond the scope of this study, but it is an important area for research in this area.

Conclusions and Summary

Visitors to leisure organizations have a great deal of choice as to which institutions they will visit, what exhibits they will explore, how long they will engage and what technology they will use. With diminishing funding and an increased need to attract visitors, many leisure institutions are looking at ways to attract visitors and provide exceptional experiences. Audio tours have been a successful staple for institutions to provide visitors with greater information and give users a richer experience and greater connection to their collections. Multimedia mobile tours appear to be a further step in creating a deep experience for visitors and a way to increase learning and engagement. However, technology adoption is challenging and introducing a flawed technology to visitors may cause frustration, distraction and dissatisfaction. This study has explored the design of mobile multimedia tours and found guiding principles that can provide a mobile tour that visitors will find easy to use and valuable, thus leading to acceptance and adoption of this new technology.

Providing a new, exciting approach for visitors to access information and engage with sites can greatly enrich both the institution and the visitors they serve. This study hopes to pave the way to this end by giving visitors a valuable new tool for engagement and learning, and to develop a tour experience that is novel, enjoyable and that can be created with low-cost.

I liked how independent I felt…It's not bound by time, or day, or, you don't have to have someone leading the tour. All you need is the little tablet. I just thought, "That's so cool."

(Penny, Study Participant)

APPENDIX A – IRB APPROVAL

Office of Research Compliance
Human Studies Program

UNIVERSITY of HAWAI'I® MĀNOA

November 27, 2013

TO: Malia Mallchok
Principal Investigator
Educational Technology

FROM: Denise A. Lin-DeShetler, MPH, MA
Director

SUBJECT: CHS #21760- "Design Elements to Enhance Adoption of a Mobile Multimedia Historical Tour"

This letter is your record of the Human Studies Program approval of this study as exempt.

On November 26, 2013, the University of Hawai'i (UH) Human Studies Program approved this study as exempt from federal regulations pertaining to the protection of human research participants. The authority for the exemption applicable to your study is documented in the Code of Federal Regulations at 45CFR 46.101(b)(Exempt Category 2).

Exempt studies are subject to the ethical principles articulated in The Belmont Report, found at http://www.hawaii.edu/irb/html/manual/appendices/A/belmont.html.

Exempt studies do not require regular continuing review by the Human Studies Program. However, if you propose to modify your study, you must receive approval from the Human Studies Program prior to implementing any changes. You can submit your proposed changes via email at uhirb@hawaii.edu. (The subject line should read: Exempt Study Modification,) The Human Studies Program may review the exempt status at that time and request an application for approval as non-exempt research.

In order to protect the confidentiality of research participants, we encourage you to destroy private information which can be linked to the identities of individuals as soon as it is reasonable to do so. Signed consent forms, as applicable to your study, should be maintained for at least the duration of your project.

This approval does not expire. However, please notify the Human Studies Program when your study is complete. Upon notification, we will close our files pertaining to your study.

If you have any questions relating to the protection of human research participants, please contact the Human Studies Program at 956-5007 or uhirb@hawaii.edu. We wish you success in carrying out your research project.

1960 East-West Road
Biomedical Sciences Building B104
Honolulu, Hawai'i 96822
Telephone: (808) 956-5007
Fax: (808) 956-8683

APPENDIX B – COPY FOR COE TOUR AUDIO COMMENTARY

Stop 1: Wist Hall

Welcome to the first stop on the COE tour, Wist Hall. The construction of Wist Hall signified a major shift for education in Hawai‘i. Before 1931, only secondary school instructors required a bachelor's degree. Elementary school teachers would attend the Territorial Normal and Training School for certification and would not receive a bachelor's degree upon graduation.

Wist Hall was built as a new site for the Territorial Normal and Training School in 1930. Its close physical proximity with the University was intended to create a closer association with the University, and as a result, to help raise the level of training for Territorial Normal and Training School students.

Leading this move to improve teacher education in Hawai‘i was Benjamin O. Wist, principal of the Territorial Normal and Training School since 1921. Benjamin Wist believed that local teachers, not mainland-trained teachers, were vitally important to the education of Hawai‘i 's children. He strove to increase the rigor of the Territorial Normal and Training School curriculum.

The desired closer association with the University came very quickly. On September 1, 1931, just one year after the Territorial Normal and Training School relocated to the new building, the legislature and the Hawai‘i Board of Regents merged the current University’s School of Education with the Territorial Normal and Training School to create Teachers College, an institution to train all teachers, both elementary and secondary, and conferring on all graduates a bachelor of education degree.

The Teachers College was composed of two schools, the School of Elementary Education, K through 8, and the School of Secondary Education, 9 through 12. With the merger, Benjamin O.

Wist was named Dean of Teachers College. Dean Wist retired in 1948 and served as a regent for the University until his death in 1951. That same year, the Teachers College building was renamed Wist Hall in his honor. In 1959, Teachers College was renamed the College of Education.

Wist Hall is a two-story, L-shaped wood and stucco building built in the Spanish Eclectic Revival style. It has a double-pitched clay tile roof with an octagon tower. The building was designed by noted architecture, C.W. Dickey, who was active during the Territorial Period. Wist Hall is notable as the only building on the UH campus by Dickey. Built for $150,000, it was the first building in a complex of buildings planned by Dickey. None of the other buildings in the planned complex were ever built.

The main entry for Wist Hall is on the east façade, where you're standing. Look above the doors to see the arch relief with the Hawaiian-inspired woodcut mural. You'll also see the historic light sconces mounted on both sides of the entryway. Look up to see four vertical window openings on the upper level. Additional entries to the building are located on the south and west facades. The entryway to Wist Hall from the south façade leads to the main classroom space. There are four classrooms on the first floor. Beyond the classrooms, there is a three-story open atrium under the tower. A staircase wraps around this space to lead to the second floor.

Beyond the atrium on the first floor lies the Andrew W. S. In College Collaboration Center, a collaborative work space named in honor of Andrew W. S. In, Dean of the College from 1980 to 1984. Racetrack hallways from the east façade on each floor connect the offices and classrooms. An additional classroom and the Learning Design and Technology Lab are located on the second floor at the top of the atrium staircase.

Wist Hall also houses faculty and staff offices for several academic departments, including Educational Psychology, Educational Foundations, Educational Administration, Learning Design and Technology, and Special Education.

Wist Hall is on the Hawai‘i State Register of Historic Places. Although the exterior remains almost exactly as it was in 1930, the interior was renovated in the 1980s. Click the peak inside icon, the keyhole, to see inside Wist Hall today. Click the look back icon, the magnifying glass, to see historical photographs of Wist Hall and Teachers College. Step into Teachers College's past by clicking the footprints. When you're ready to move to the next stop, click on the map icon.

Stop 2: Castle Memorial Hall

Welcome to Castle Memorial Hall. The pathway in front of you leads to the building's main entrance. Built in 1941, as a training facility for kindergarten and preschool teachers, it still serves young children today, housing the University of Hawai‘i at Mānoa Children's Center, preschool facilities for UH students, faculty, and staff, as well as classrooms for the University Laboratory School, now a Hawai‘i State Department of Education charter school, but formerly the training facility for Teachers' College and later the College of Education.

Staff and faculty offices for the college's Curriculum Research and Development Group are also found here. The building is listed on the Hawai‘i State register of historic places. The construction for Castle Memorial Hall was funded by the Samuel and Mary Castle foundation, with a gift of $300,000 in November of 1939.

Samuel and Mary Castle were strong supporters of progressive early education for Hawai‘i 's children in honor of their son Henry, and their kindergarten-age granddaughter Dorothy Castle, who were tragically lost it on the SS Elbe in 1895 when they were returning to Hawai‘i from a trip to Germany. The Castles first opened the Castle Memorial kindergarten in 1899, with the help and input of the renowned educational reformer John Dewey, a family friend. The training center on the UH campus, Castle Memorial Hall was a natural extension of the Castle's mission to bring progressive education to Hawai‘i 's youngest students. The Castle Memorial kindergarten was moved from his previous location near Kawaihao Church, to Castle Memorial Hall when it opened in 1941.

The training center was constructed by architect Mark Potter, with input from mainland architects, preschool educators, and UH Deans Benjamin Wist and Arthur Keller. The building was built with young children in mind, and with an intention to merge the interior and exterior spaces. Rooms feature tall glass sliding doors leading to wide lanais with ramps to fenced-in play yards with wading pools in sandboxes. The building is a one-story, irregular structure built in the Early Territorial architectural style. There are 16 major facades all different in size and content. Windows are either eight foot tall single hung hopper windows, or six foot single hung windows. The north facade, the largest, features 50 openings for single hung and hopper windows. The foundation is made from lava rock masonry and the roof is a double-pitched roof that transitions to a shed roof.

Construction of Castle Memorial Hall began in early 1941 with an expected completion date of November 1941. During construction, setbacks occurred when the US military begin confiscating materials, particularly plumbing fixtures, due to the increase in military activity in the islands. However, the small child-size toilets were returned for use in the new building. Soon after Castle Memorial Hall opened as planned, the University was closed due to the Pearl Harbor attacks. During the war, Castle Memorial Hall was used by Punahou School, as its facilities were used by the US military. In 1945, Punahou School returned to its campus, and Castle Memorial Hall was again used by the University.

As you look down the pathway in front of you, you'll see the remnants of the wading pools and fountains, unfortunately currently non-functional, on the lawn to your right. Imagine the pathway covered by a trellis covered in vines, as it was until 1976. Click on the peek inside icon, the keyhole, to see current photographs of Castle Hall's interior click on the step into the past icon to immerse yourself in Castle Hall's past. Click on the look-back icon, the magnifying glass, for historical photographs

Stop 3: University High School Building 1

Before you is University High School Building 1 built in 1943 for $88,000. UHS 1 was the only civilian building built on the University campus during World War II. Initially constructed as intermediate classroom facilities and an educational laboratory for the Teachers College, it was

called Teachers College Intermediate School, and only became known as University High School in 1947.

UHS 1 is a single-story building with single wall construction built in the Early Territorial Style. It is a post and pier building with a gable on hip roof. From where you're standing, you can see how UHS 1 was built to accommodate the slope it's constructed on. Look at the corner of the building the Metcalf Street side, and you'll see that the building lies on a concrete foundation, but if you look at the opposite corner, you'll see the building raised up with horizontal slats concealing the foundation.

Entryways are located on the south, west, north and northwest facades. As you look down the fire lane that runs along the building, you'll see the two south entryways, both with low wooden stairs. From the corner where you're standing, you'll see the west façade and the two sets of seven windows with wooden louvers. The rest of the building's windows appear in a pattern consisting of two types of windows. A short double hung four-panel window or long double hung four-panel window over a hopper window.

The building is J-shaped and you are standing the base of the J. The area next to where you're standing contains three classrooms making the hook of the J. Inside the hook lies a semi-enclosed patio or garden space. Until recently, art, science and general instruction classes for the College's Institute for Teacher Education were held in this building, and it housed offices for College faculty and staff.

In the summer of 2015, the ceiling in the art classroom began to fall and inspection by the University revealed that the building suffered from structural damage, resulting in insufficient integrity to hold nails. The classroom was vacated permanently but the rest of the building remained in use. In September of this year, the ceiling in the hall of UHS 1 fell and the ceiling in the women's restroom began sagging. In October 2015, the building was deemed unsafe and remaining classes were relocated, some to the opposite side of campus, and the building was closed.

Click on the peak inside icon, the keyhole, to see a video of the building's exterior and interior spaces from what it was still in use. Click on the step into the past icon, the footprints, to join students in a weather experiment in 1961. When you're ready to move on to the next stop, click on the map icon and look for Stop Four.

Stop 4: UHS 2

Built in 1984, University High School Building 2 was the first post-World War II building constructed on the UH campus, and the first high school building built for the University Lab School. With the introduction of the University Lab School high school program, for the first time it was possible for a student to be educated from kindergarten to graduate school on the Mānoa Campus. From the sidewalk where you're standing, the building appears to be a raised one-story structure. However, the south side of the building, facing Castle Memorial Hall, has a basement on the west end of the structure where the grade slopes down approximately five feet.

Low wood staircases and centered recessed entries appear on each of the four facades, with the east entry considered the main entry. Inside, the building consists of two intersecting corridors that provide access to all interior offices. The building is single-wall wood construction in the Early Territorial style. The building has a T-shaped plan with a gable on hip roof. Double hung and hopper widows lead along the north, east, and south facades. There are no windows on the west façade.

Look above the double door entry on the east façade where you're standing. You'll see the wood framed slats that provide natural ventilation for the structure. These slats appear on the other entries as well, creating the opportunity for cross breezes inside the building. UHS 2 has been in a state of critical disrepair for decades. In 1993, the Hawai‘i Department of Accounting and General Services reported, in reference to UHS 1 and UHS 2;

Several of the older wooden buildings built around the time of World War II are deteriorating structurally, and the spaces therein are functionally inadequate and obsolete. Constructed according to building codes, which have been superseded, some of these buildings do not meet current standards and pose safety and health hazards.

In response, the Hawai‘i State Legislature approved funding for planning and construction of a new College of Education building to be constructed on the present site of UHS 1 and UHS 2. A ground-breaking ceremony was held in December 1993 for construction of a 180,000 square foot education building to be completed at a cost of $11.5 million. Sadly, this project ended almost before it began, and in 1994, Governor Cayetano canceled the project, stating state budget shortfalls.

By the year 2000 the funding had lapsed, and the College of Education Dean at the time, Randy Hitz began a new campaign for a new College of Education building. Since that time, despite consistent efforts by the College of Education, a new building has failed to receive legislative funding. In the summer of 2014, the deteriorating condition of UHS 2 resulted in vacating the building due to health and safety concerns. Faculty and staff were relocated to other offices in COE buildings and across the UH campus. UHS 2 remains empty today.

Click on the Peak Inside icon, the keyhole, to see photos from inside UHS 2, taken after it was vacated. Click on the Look Back icon, the magnifying glass, to see the building’s original architectural plans. When you're ready to move to the next stop click on the map icon to return to the tour map and look for stop five.

Stop 5: Everly Hall

Across the parking lot from where you're standing, you'll see Everly Hall, built as Wist Annex 2 in 1963 for $453,000. Currently, it houses the College of Education's administrative offices, including the Dean's Office, as well as faculty and staff offices. Although it appears to be connected to Wist Hall, there is no connecting passageway between the two buildings.

In 2006, the building was renamed Everly Hall to honor former Dean Hubert Everly. Dean Everly came to Hawai‘i in 1933 intending to study volcanology and become a park ranger. Instead, Everly met Dean Benjamin Wist, and perhaps more importantly, Benjamin Wist's daughter, Zoe, who he later married.

Wist encouraged Everly to enter the Teachers College, and Everly received both his B.Ed and M.Ed from UH. He later received his PhD from Ohio State. He returned to Hawai‘i as principal of the University High School in 1946, and subsequently acted as Director of Secondary Education, Department Chair, and finally Dean of the College of Education from 1956 to 1980. In a 1991 interview conducted after his retirement, Dean Everly spoke about the unique nature of Teachers College.

The college was a unique college. It served a unique purpose in these islands, and it made us very conscious of the problems here of the social structure and the feudalistic economic system we had here in the islands, so that we became far more than educators. We became what we considered the social revolutionaries. That's what we thought of ourselves. The book we liked to read in those days was, 'Dare the Schools Create a New Social Order?' That was our bible. Yes, we dare create a new social order, and we're going to do it through public education. We weren't just trying to get the kids jobs. We were trying to get them jobs and hoping then, they would transform society after they got out into it, and they did.

As Dean Everly began his tenure as Dean, Teachers College was just starting a major expansion to address a shortage of teachers in the islands. From 1955 to 1960, each entering freshman class was increased from approximately 180 students previously to 400 students. In 1956, there were 1,300 students enrolled in the college, jumping to 1,444 students in 1957. The University also began a 15 month auxiliary teaching program for Arts and Science graduates to help meet the demand for teachers in Hawai‘i.

Today the College has over 1,600 students, and offers programs from Early Childhood Education to Educational Technology to Kinesiology to Hawaiian Education. With five undergraduate degrees, two post baccalaureate certificates, four graduate certificates, nine masters degrees, and nine doctoral specializations, the college awards over 700 degrees each year, and it consistently ranks among the top 100 graduate schools of education in US News and World Report.

Most importantly, the College stays true to its long-standing purpose to serve education in Hawai‘i and to find answers to the problems that confront our schools, and developing solutions

to address those challenges. Click on the Peek Inside icon, the keyhole to see inside Everly Hall. Click on the Look Back icon, the magnifying glass, for historical pictures of Everly Hall. When you're ready to move on to the final stop on the tour, click on the Map icon and look for Stop 6.

Stop 6: The Fire & the Future

You are standing near the former location of the University Elementary School building. Built in 1939, for $57,000, this structure was build to house elementary facilities for the Teachers College. On the afternoon of June 13, 2006, a fire alarm went off in the University Elementary School building. At the time, the building housed offices for the College's Curriculum Research and Development Group as well as the University Lab School's drama, orchestra, theater, physical education program and athletics department. College of Education personnel for the Hawai‘i Institute for Educational Partnerships, the Hawai‘i Education Policy Center, and the Center on Disability Studies also had offices in this building.

Expecting a false alarm, staff investigated only to find flames coming from the drama classroom. The fire department was called, and although attempts were made by faculty and staff to douse the fire, the flames quickly consumed the old wood and the building was evacuated. The fire rapidly spread and soon fire fighters retreated from inside the building as the ceiling began to collapse. Nearby houses and offices were evacuated as thick, black smoke enveloped the area and flames reached 50 to 60 feet high.

Two hours later, the building was completely consumed and the fire was under control, although fire fighters remained on the scene putting out hot spots until 11:00 p.m. that night. In one afternoon, a building that had served Hawai‘i students and student teachers for 67 years had been destroyed. Fortunately no one was injured and everyone was able to evacuate the building safely.

The loss of the Elementary School Building left both the College and the University Lab School with a significant loss of office and classroom space. By December of 2006, four small structures were installed to serve as temporary replacement for the lost offices and classrooms. At the end of the road, between UHS 1 and 2, you'll see these four temporary structures. In the nine years since the destruction of the University Elementary School building, there's been no funding

provided by the University or the Hawai‘i State Legislature to replace the building with a permanent structure.

The loss of the University Elementary School office and classroom space combined with the recent closure of both UHS 1 and 2, has left the College in space crisis. Today, space for both students and faculty has become a primary concern for the College, as enrollments have increased and the College has hired additional faculty and staff. The ability of the College to meet current and future demands is now in jeopardy. The current facilities do not meet accreditation requirements. An accreditation team site visit in April, 2014, concluded:

Space allocated to the unit for instruction, faculty, and research does not support learning, research, and scholarship.

If you look across the road, away from Metcalf Street, toward Castle Memorial Hall, you'll see construction in progress in the field between UHS 2 and Castle Memorial Hall. On June 15, 2015, the COE broke ground for the construction of two net zero energy 1,500 square foot classrooms. These two structures, to be powered by Photovoltaic or PV arrays on the roofs, will generate as much energy as they will use. Developed by Project Frog, an architectural firm based in California, the construction of the structures is being funded by the University's Hawaii Natural Energy Institute, through a grant from the Office of Naval Research.

To reduce construction cost and time, the structures are pre-fabricated and assembled onsite. They are two of five similar structures built in Hawai‘i. The College expects construction to be complete and the classrooms in use by summer of 2016. These two new structures will provide some relief for the College's immediate classroom space crisis, but a new building is still a critical need for the College to continue of the prepare Hawai‘i 's teachers. Aware of these challenges, the College continues its efforts to obtain funding for a new building to appropriately educators for 21st Century learning.

Click on the Step Into The Past icon, the green footprints, to experience the aftermath of the fire. Click on the Look Back icon, the magnifying glass, to see photos of the day of the fire. Click on

Peek Inside icon, the keyhole, for photos of the FROG Construction. This is the final stop on the COE Tour. Once you have finished exploring this stop, click End to complete the tour.

APPENDIX C – COE TOUR STEP INTO THE PAST COPY AND PHOTOGRAPHS

Step Into the Past: Wist Hall

It is a beautiful day in 1972 and faculty and students are milling about outside of Wist Hall.

Step Into the Past: Castle Memorial Hall

It is a hot day in 1956 and preschoolers enjoy a dip in the wading pool on the lawn outside Castle Memorial Hall. Today, nearly 60 years later, preschoolers still enjoy splashing in inflatable pools and running through sprinklers on this lawn.

Step Into the Past: University High School Building 1

Join two elementary students as they perform a weather experiment outside UHS 1 on a rainy day in 1961.

Step Into the Past: The Fire & the Future

It is June 14, 2006. You are looking at the remains of the University Elementary School building that was consumed by fire the day before.

APPENDIX D – SURVEY INSTRUMENT, COE TOUR V1.0

* Required

Name *

Gender *

- ○ Male
- ○ Female

Age *

- ○ 18-24 years old
- ○ 25-34 years old
- ○ 35-44 years old
- ○ 45-54 years old
- ○ 55-64 years old
- ○ 65-74 years old
- ○ 75 years or older

College of Education (COE) affiliation *

- ○ Former COE faculty/staff
- ○ COE Alumni
- ○ Current COE Faculty/staff
- ○ Current COE student
- ○ Relative of COE faculty, staff or student
- ○ No COE affiliation

I feel _____ using mobile technology (smartphones, tablets, etc.) *

	1	2	3	4	5	
Extremely Uncomfortable	○	○	○	○	○	Extremely Comfortable

I enjoyed this multimedia tour *

1 2 3 4 5

Strongly Disagree ◯ ◯ ◯ ◯ ◯ Strongly Agree

The part of the tour I enjoyed the most was: *

- ◯ Historical photos
- ◯ Current photos
- ◯ Video
- ◯ Step Into the Past
- ◯ Audio tour

The part of the tour I enjoyed the least was: *

- ◯ Historical photos
- ◯ Current photos
- ◯ Video
- ◯ Step Into the Past
- ◯ Audio tour

The content of the tour was interesting to me *

1 2 3 4 5

Strongly Disagree ◯ ◯ ◯ ◯ ◯ Strongly Agree

This tour increased my knowledge of the College of Education's history. *

1 2 3 4 5

Strongly Disagree ◯ ◯ ◯ ◯ ◯ Strongly Agree

This tour increased my appreciation of the College of Education. *

1 2 3 4 5

Strongly Disagree ○ ○ ○ ○ ○ Strongly Agree

The tour was easy to use *

1 2 3 4 5

Strongly Disagree ○ ○ ○ ○ ○ Strongly Agree

I would recommend this tour to others *

1 2 3 4 5

Strongly Disagree ○ ○ ○ ○ ○ Strongly Agree

What were the most valuable or enjoyable aspects of the tour? *

Were there any aspects of the tour that were confusing or too complicated? If so, please describe.

Please comment on aspects of the tour that need improvement.

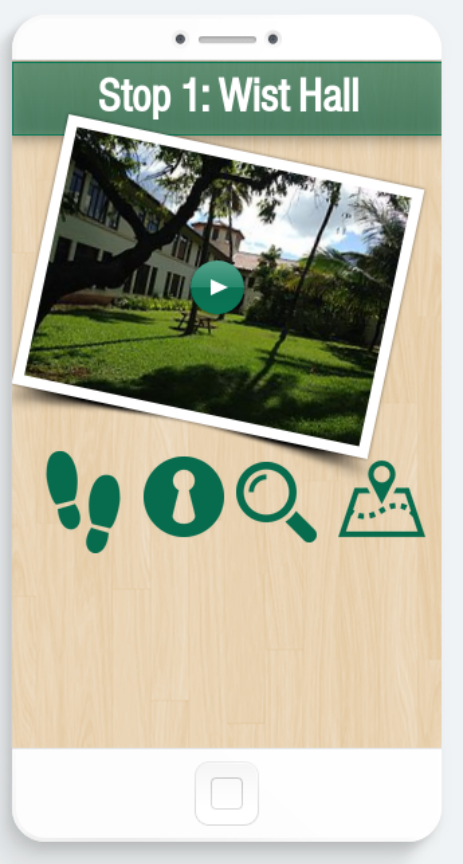
Are there any other comments you would like to add about the tour and your experience with it?

APPENDIX E – SURVEY INSTRUMENT, COE TOUR V2.0

COE Tour Follow-Up
Thank you for participating in the COE tour research project in January. Your input was very valuable. Based on participant response, the tour has been modified. Could you complete the following survey to provide feedback on the new design? Your participation is purely voluntary, but would be greatly appreciated. Thank you!

First Name *

Original Tour Stop Page - This page can be viewed here: http://tinyurl.com/wistold



I wanted more control over the content I viewed during the tour. *

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

I was bored or restless just looking at the buildings while listening to the audio tour. *

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

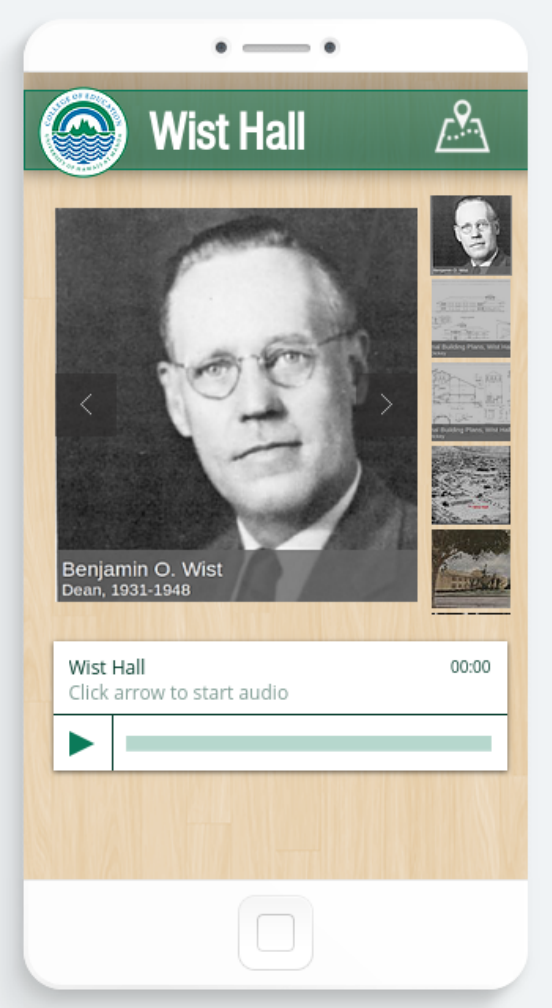
I would have liked to have been able to view the photos while listening to the audio portion of the tour. *

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

I like to focus on one thing at a time. *

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

Revised Tour Stop Page - Please view the revised tour stop page here: http://tinyurl.com/wistnew.



Which version do you prefer? *

- ○ Original
- ○ Revised

Why?

I can best access information the way I prefer using the _____. *

- ○ Original tour
- ○ Revised tour

Which tour is easier to use? *

- ◯ Original
- ◯ Revised
- ◯ Both the same

I would use a tour similar in design to the original tour *

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

I would use a tour similar in design to the revised tour *

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

Which tour would you recommend to others? *

- ◯ Orginal tour
- ◯ Revised tour
- ◯ Neither

Please provide any additional comments or suggestions on either the original or revised tour.

Do you have any other comments?

APPENDIX F – CODEBOOK

User Control		
	Media Control	Ability to control the audio player (pause, play, rewind, etc.)
	Content Choice	Ability to select which type of content to view (architecture info, history, etc)
	Content Presentation	How information is presented (text, video, visuals, etc.)
	Sequence Choice	Control over which stops to view and when
Tour Design		
	Interface	General interface appearance and functionality
	Icons	Appearance and functionality of icons
	Amount of Content	Is amount of content appropriate, acceptable?
	Tour Map and Orientation	Is the map sufficient for navigation? How easy is it to find stops?
Tour Experience		
	WiFi	Network connectivity and impact on tour/viewing content

	Viewing Experience	Physical factors (like sunlight) that impact consuming content on the tablet
	Dramatization	Use of different voices for audio content
	Stimulation and Interaction	Level of stimulation during the tour. More interaction needed? Were participants bored?
	On-Site Experience	Would the impact of the tour be less if the taken virtually and not on-site? What is the impact of taking the tour on-site versus virtual?
	Content Value	Was the content of the tour valuable and interesting?
	Appreciation of Site	Did participants have a greater appreciation of the COE after taking the tour?

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